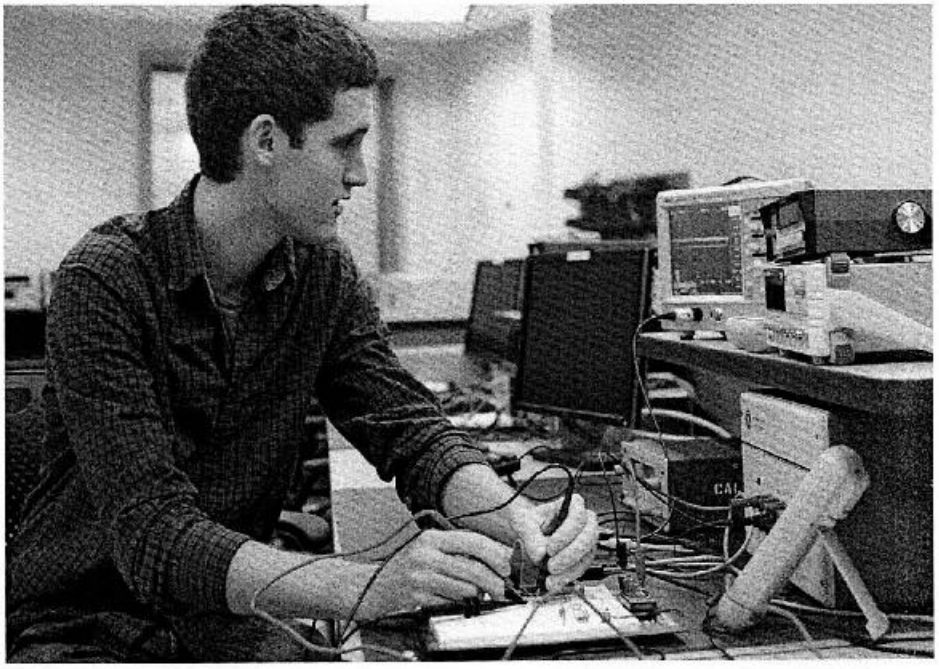
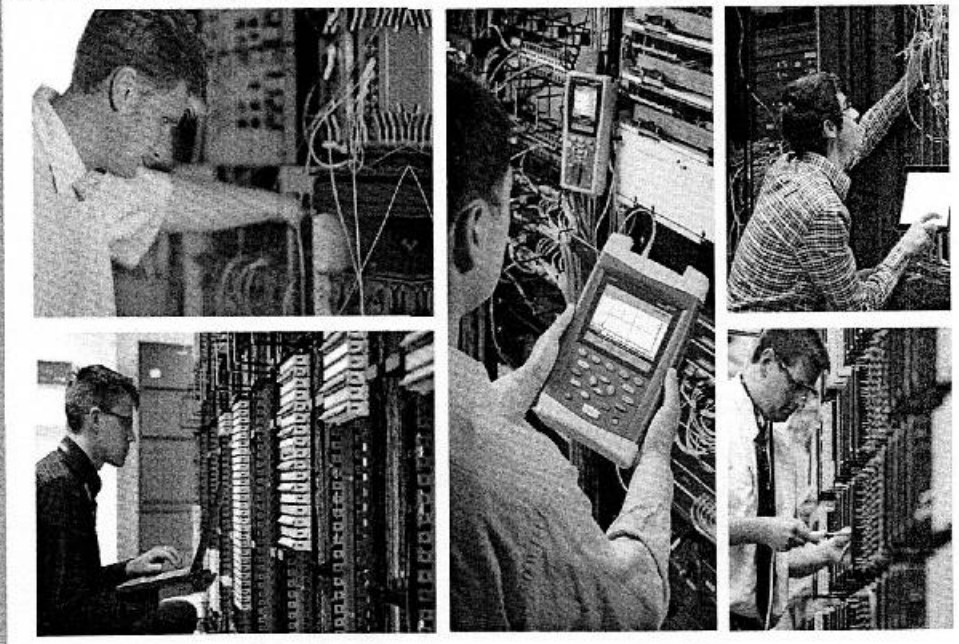
الجامعة الليبية
كلية التكنولوجيا

FACULTY OF TECHNOLOGY
Communications and Computer Networks Engineering



Curriculum
Bachelor of Engineering
Communications and Computer Networks Engineering



2019

Curriculum
Bachelor of Engineering
Communications and Computer Networks Engineering

Summary

General Presentation and Objectives.

The Department of Computer and Communication Networks Engineering uses a new approach of higher education with a practical learning that allows students to acquire advanced knowledge in the technological framework. It develops skills in IT, Electronics, Telecommunications and Networks and introduces New Technologies in these areas. Students study in French or English to obtain two degrees: Bachelor and Master.

After three years, the Bachelor trains executives, ready to fit into the professional environment. Thus, graduates will be able to carry out technological and commercial tasks related to the following areas: Network Administration, Telecommunications, Analysis and Processing of Data and Signals, Computer Development, Study of several programming languages, Programmable Circuits...

The courses are organized in lectures (CM), tutorials (TD), and practical work (TP), in varying proportions depending on the subject.

Graduates can continue their studies in Master especially in Master GSI (Engineering of Information Systems) and Master GST (Engineering of Systems and Telecommunications) in the Faculty of Technology-Saida. They can also continue their studies in Engineering or Master in Lebanon or France.

CCNE

LIBANESE UNIVERSITY
Faculty of Technology

Curriculum
Bachelor of Engineering
Communications and Computer Networks Engineering

الجامعة اللبنانية
كلية التكنولوجيا

L1

Semester 1

Code	Course	ECTS	CM	TD	TP	Total
LS1ALGE	Algebra I (CE-IME-CCNE-BC)	3	15	15		30
LS1ANAL	Calculus I (CE-IME-CCNE-BC)	4	18	27		45
LS1ARCH	Computer Architecture CCNE- BC)	3	18	12		30
LS1CIEL	Electric Circuits	5	18	24	18	60
LS1ELNU	Digital Electronics I	4	15	18	12	45
LS1FRAN	English (CE-IME-CCNE-BC)	2		30		30
LS1ININ	Introduction to Computer Science (CCNE-BC)	4	15	18	12	45
LS1OPTI	Optics	4	15	21	9	45
Total	8	29	114	165	51	330

Semester 2

Code	Course	ECTS	CM	TD	TP	Total
LS2ALGE	Algebra II (CE-IME-CCNE-BC)	3	15	15		30
LS2ANAL	Calculus II (CE-IME-CCNE)	4	18	27		45
LS2DRHO	Human Rights (CE-IME-CCNE-BE)	2	30			30
LS2ELAN	Analog Electronics I (IME-CCNE)	4	15	18	12	45
LS2PRST	Structured Programming (CCNE-BC)	4	12	18	15	45
LS2RELN	Computer Network I (CCNE-BC)	5	21	21	18	60
LS2STPA	Applied Statistics and Probability	4	18	27		45
LS2THSI	Signal Theory	3	15	15		30
Total	8	29	144	141	45	330

L2

Semester 3

Code	Course	ECTS	CM	TD	TP	Total
LS3ANAL	Calculus III (IME-CCNE)	3	12	18		30
LS3BDDR	Relational Database I (CCNE-BC)	4	15	15	15	45
LS3ELAN	Analog Electronics II	4	15	18	12	45
LS3ELNU	Digital Electronics II	4	15	18	12	45
LS3LAOO	Object Oriented Language	4	15	15	15	45
LS3REEW	Wide Area Network	4	15	15	15	45
LS3REIN	Computer Network II (CCNE-BC)*	4	12	15	18	45
LS3STDO	Data Structure (CCNE-BC)	4	12	18	15	45
LS3TEAN	Analog Communications	4	15	15	15	45
Total	8	31	114	132	99	345

Semester 4

Code	Course	ECTS	CM	TD	TP	Total
LS4ATGL	Computer Software Engineering	4	15	15	15	45
LS4AULI	Linear Control (IME-CCNE)*	4	12	15	18	45
LS4CIPR	Programmables Circuits (IME-CCNE)	4	12	15	18	45
LS4ENCO	Communication Skills (CE-IME-CCNE-BC)	2		15	15	30
LS4LITR	Transmission lines	4	15	18	12	45
LS4RELL	Local Area Network	4	15	15	15	45
LS4SYEX	Operating Systems (IME-CCNE)	4	15	15	15	45
LS4TENU	Digital Communications	4	15	15	15	45
LS4TRNS	Digital Signal Processing*	4	12	12	21	45
Total	8	30	99	120	126	345

L3

Semester 5

Code	Course	ECTS	CM	TD	TP	Total
LS5ADRE	Network Administration	4	15	15	15	45
LS5ANGL	French (CE-IME-CCNE-BC)	2		30		30
LS5DEWE	Web Development (Client side)	4	15	15	15	45
LS5MITE	MicroWaves and Teledetection	4	12	18	15	45
LS5PRVH	VHDL Programming (IME-CCNE)	4	15	15	15	45
LS5PRAN	Antena and Propagation	4	15	15	15	45
LS5SYOP	OptoElectronics Systems	4	15	15	15	45
LS5WLES	WLAN and Security	4	15	15	15	45
Total	8	30	102	138	105	345

Semester 6

Code	Course	ECTS	CM	TD	TP	Total
LS6STAG	Internship	6				
LS6PRFE	Senior Project (≥ 180 h / étudiant-projet)	12			180	180
LS6DRGT	General and Labor law (CE-IME-CCNE-BC)	1	15			15
LS6COEL	Electromagnetic Compatibility*	3	9	12	9	30
LS6TESA	Satelite Communication*	3	15	15		30
LS6TEFI	Fixed Telephony*	3	15	6	9	30
LS6TEMO	Mobile Telephony*	3	12	9	9	30
LS6ARCS	Client Server Architecture*	4	15	15	15	45
LS6PRRS	Network Systems Programming*	4	15	15	15	45
LS6PRTR	Real Time Programming*	4	15	15	15	45
Total	7	31	60	45	225	330

*: electives Courses - ECTS : European Credit Transfer and accumulation System - CM : Course - TD : Exercices - TP : LAB

Total ECTS :	180
Total Hours :	2025

Semester 1

Semester 1						
Code	Course	ECTS	CM	TD	TP	Total
LS1ALGE	Algebra I (CE-IME-CCNE-BC)	3	15	15		30
LS1ANAL	Calculus I (CE-IME-CCNE-BC)	4	18	27		45
LS1AROR	Computer Architecture CCNE- BC)	3	18	12		30
LS1CIEL	Electric Circuits	5	18	24	18	60
LS1ELNU	Digital Electronics I	4	15	18	12	45
LS1FRAN	English (CE-IME-CCNE-BC)	2		30		30
LS1ININ	Introduction to Computer Science (CCNE-BC)	4	15	18	12	45
LS1OPTI	Optics	4	15	21	9	45
Total	8	29	114	165	51	330

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS1ALGE	Algebra 1	1	3	15	15	0

Department: IME - CCNE - CE -BC

Objectives:
Give the students the necessary mathematical tools for the follow-up of the basic courses or the specialization courses, in the context of the formation such as: the complex numbers, calculations on the polynomials and rational fractions, use of linear algebra concepts-matrix calculation.

Content:

The complex numbers

Introduction
Definition of complex numbers and laws of composition
Algebraic form of a complex number
Conjugate of a complex number and properties
Trigonometric form of a complex number
Exponential form of a complex number
Fundamental theorem of algebra

Real polynomials and rational fractions

Definitions and notations
Operations on polynomials
The Euclidean division and the degree of multiplicity
Factorization of a real polynomial
Rational fractions
Irreducible and proper rational fractions
Decomposition of a rational fraction into partial fractions

Real vector space

Real vector space and examples
Real subspace
Linearly independent and generating families of vectors
Bases and dimension of a finite real vector space

Matrices 1

Definitions and special matrices
Square sub-matrices of a matrix

Code	Title	Semester	Credits	Courses	Exercises	LAB
.S1ANAL	Calculus I	1	4	18	27	0

)epartment: IME - CCNE - CE

)bjectives:

Jive students the basic mathematical tools such as the study of functions, Taylor series :xpansions and integration of functions.

:ontents:

Real Functions of Real Variable: Definitions, Operations on functions, Properties of functions, .imits of functions, Infinite branches – Asymptotes.

:ontinuity and Derivability of Real Functions: Continuity, Monotony, Inverse function,)ifferentiability, Rolle's Theorem, Mean Value Theorem.

Jsual Real Functions: Steps for studying a Function, Circular functions, Inverse circular unctions, Logarithmic functions, Exponential functions, Power functions, Hyperbolic functions, nverse hyperbolic functions.

'inite Expansions: Definitions, Finite expansion of usual functions, Properties of finite :xpansion, Applications of finite expansions.

ntegrals: Primitives, Definite integrals, Integration methods, Applications, Improper integrals.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS1AROR	Computer Architecture	1	3	18	12	

Departments: CCNE - BC

Objectives:

Know the architecture of the computer and the functions of its main components, such as logic circuits, microprocessors, memories, and interface circuits.

Contents:

Computer History and Design:

Introduction to computer architecture
Different generations/machine levels
Information and number coding

Digital systems

Number systems (decimal, binary, octal, hexadecimal numbers), conversion among bases
Fractions
Complements
Signed Binary Numbers
Representing characters
Image data
Digital logic gates (NOT, AND, OR, NAND, NOR, XOR, XNOR)

Central processing unit

Computer organization
Computer system buses
Computer performance measures (clock rate, CPI, MIPS, Speedup)
Amdahl's law
Micro-machine and micro-programming concepts
Instruction Sets (Characteristics and Functions, Addressing Modes and Formats)

Memory Hierarchy and management

Main Memory
ROM (Read Only Memory)
Cache Memory operation and performance (miss/hit)
Cache memory - placement policy
- Direct mapping
- Example on direct mapping
- Associative mapping
- Example on associative mapping
- Set associative mapping
- Example on set associative mapping

Pipelining

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS1CIEL	Electric Circuits	1	4	18	24	18

)epartment: CCNE

)bjectives:

'his course aims to give students the basic concepts, laws and theories related to electricity that re the tools to solve practical problems in electrical circuits under different regimes, electronics nd electromagnetism.

'ontent:

3asics notion: Current and voltage, Sources (independent and dependent), Ohm's law, Kirchhoff's laws (KVL and KCL), Power stored or dissipated in a circuit, transformation ((Δ to Y), resistors in series& parallel, current and voltage divider rules.

'ontinuous regime: Node- voltage method, mesh current method, source transformation, Thevenin and Norton theorems, maximum power transfer and superposition theorem.

Transient regime: first order and second order circuits: free response of a circuit RL, RC and RC.

Sinusoidal signal: sinusoidal signal (mean value, rms value, modulus ...), complex representation of the sinusoidal signal, circuit analysis techniques (Node voltage method, mesh current method, ource transformation, Thevenin theorems and of Norton, maximum power transfer and uperposition theorem). Power (instantaneous, average, reactive, complex and apparent) and naximum signal transfer.

Two-ports and passive filters: Linear network transfer functions. Impedance matrix, admittance, ybrid parameters, High pass filter, low pass, band pass and band cut-off filter.

'AB Sessions:

TP1- Electrical measurements (using a multimeter, voltmeter, ammeter and ohmmeter).
TP2- Resistors in series and parallel. Voltage divider and current divider.
TP3 Thevenin Theorem.
TP4- Superposition theorem.
TP5- The oscilloscope (determination of the characteristics of the periodic signals: sinusoidal, quare and triangular, position DC, AC, GND, X-Y key, amplitude, period, offset adjustment ...).
TP6- Study of the circuit R, C in transient mode.
TP7-8-9 Circuit R, L, C series in permanent sinusoidal regime: resonant frequency, phase, bandwidth, switching frequencies and quality factor.
TP10- Two ports

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS1ELNU	Digital Electronics I	1	4	15	18	12

Department: CCNE

Objective :

The purpose of this course is to familiarize the students with combinational circuits and sequential circuits, to control their use and introduce the concepts of programmable circuits in direct connection with applications in telecommunications and computer.

Contents:

Logical functions: logical operations, logical gates (technologies), Boolean algebra, Morgan's theorem
Representation and simplification of logical functions: logical algebraical expression, Karnaugh map's, simplification. Aleas and parasites
Combinational circuits: Multiplexers, demultiplexers, encoders, decoders, transcoding, comparators, adders. Implementation of encryption and decryption of information in computer and telecom
Basic functions memory: RS flip-flop, JK flip-flop, D flip-flop, T flip-flop, Master Slave flip-flop,
Counters: structure synchronous counters and asynchronous counters, synchronous synthesis from the JK flip-flops, D flip-flops and counters, incomplete cycle.
Registers: memories registers, shift registers, bidirectional register, universal register.

LAB Sessions:

LAB1: Logic Gates
LAB2: Half adder and full adder
LAB3: Binary Encoder-Transcoder
LAB4: Decoder, Seven segment display
LAB5: Multiplexers and demultiplexers
LAB6: The Flip-Flops
LAB7: Synchronous and asynchronous counters
LAB8: Registers

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS3ANGL	English	3	2	0	30	0

)epartment : CE - IME - CCNE - BC

)bjectives:

Γhe course purpose is to allow the students to reach a level of 400-500 for Toffel Exam.

Γhe course is taught in a way to strengthen the listening & speaking skills to help the students :ommunicate &express themselves easily. It also provides the students with the needed tools to mprove their English skills in reading and writing.

Γhe course allows the students to talk about himself in an interview, to give opinions & to discuss hem with a counterparty, to negotiate using a good vocabulary & to improve his performance in ıny technical or informal discussion. It also allows the student to write essays by using formal anguage and adopting the right tone & to write email letters, reports and proposals.

Code	Title	Semester	Credits	Courses	Exercises	LAB
1ININ	Introduction to Computer Science	1	4	15	18	12

Department: CCNE - BC

Objectives:

ntroduce information Systems. Acquire the basic concepts of Algorithmic. Acquire the bases of he structured programming.

Contents:

ntroduction in the notion of application and IT program. Notions of syntax, semantics interpretation, compilation). Algorithmic Concepts of the structured programming:

The types, the variables, the operators, the expressions, the declaration statements, the basic elements, the instructions (reading - writing and assignment), the sequential structures, conditional structures and repetition structures.

General formalism and representation of an algorithm: Pseudo-Code and Flowchart. Test and validation of an algorithm (Trace-table or Execution-table).

The Algorithmic Concepts are applied using C language.

LAB Sessions:

Architecture and components of a computer, Installation and Management of the peripherals of a computer, Basic Functions of Hardware and Software, File management systems.

Application of the algorithmic concepts In C language: types, variables, operators, expressions, es declarations, the expressions, the declarations statements, the basic elements, the instructions reading - writing and assignment), the sequential, conditional and repetition Control structures.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS1OPTI	Optics	1	4	15	21	9

Department: CCNE

Objectives:

The objectives of this course are to provide the basis for geometrical optics and physical optics as well as the propagation of electromagnetic waves and their practical applications.

Contents :

Geometric optics : General properties of light - Optical path - Fermat principle - Snell-Descartes laws, reflection, refraction - stigmatism - Gauss Condition - Prism - Plate with Parallel-faces - Centered optical systems – Transversal, axial and angular magnification - Cardinal elements - Conjugation relation - Object and image vergence and convergence of the optical system - Spherical diopter - Lenses - Thin lenses - Spherical mirrors - Planar mirror - A focal systems - Some applications.
Electromagnetic waves : Waves - Wave function - Sine waves - Wave vector - Transversal and longitudinal waves - Main types of wave fronts - Electromagnetic waves - Helmholtz equation - Trigonometric, Complex and vectorial (Fresnel) representations of a sinusoidal wave - Principle of superposition.
Diffraction : Definition - Huygens-Fresnel principle - Fraunhofer diffraction - Diffraction by a rectangular aperture - Diffraction of Young's slits - Diffraction of a circular aperture - Role of diffraction in optical instruments.
Interferences : Definition - Two-wave interference - Difference in running - Interference order - Young's slit experience at finite distance - Young's slit experiment in parallel light.
Polarization of light : Birefringence - Linear, elliptic, circular and natural polarization - Laws of Malus.

LAB Sessions:

Study of Snell-Descartes principles and laws of reflection and refraction as well as the classical systems of geometrical optics (mirrors, prism, thin and thick lenses, parallel-faced plate). Measurement of the index of a prism by the minimum deviation; Achromatic prism. Fraunhofer diffraction and interferences by Young's slits. Polarization of light; Law of Malus.

Semester 2

Semester 2						
Code	Course	ECTS	CM	TD	TP	Total
_S2ALGE	Algebra II (CE-IME-CCNE-BC)	3	15	15		30
_S2ANAL	Calculus II (CE-IME-CCNE)	4	18	27		45
_S2DRHO	Human Rights (CE-IME-CCNE-BE)	2	30			30
_S2ELAN	Analog Electronics I (IME-CCNE)	4	15	18	12	45
_S2PRST	Structured Programming (CCNE-BC)	4	12	18	15	45
_S2REIN	Computer Network I (CCNE-BC)	5	21	21	18	60
_S2STPA	Applied Statistics and Probability	4	18	27		45
_S2THSI	Signal Theory	3	15	15		30
Total	8	29	144	141	45	330

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS2ALGE	Algebra II	2	3	15	15	0

Departments: IME - CCNE - CE - BC

Objectives:
Give to the students the mathematical tools necessary for the follow up of basic courses or specializing courses, in the frame of formation such as: use of the concepts of linear algebra. - Matrices.

Contents:

Matrices 2
Addition of matrix and properties
Scalar multiplication and properties
Transpose of a matrix and properties
Product of two matrices and properties
Elementary row operations

The determinants of a square matrix
Definition of the determinant and properties
The inverse of a matrix and properties

Linear transformations and matrix
Linear transformation
Matrix representation of a linear transformation
Kernel, image and rank of a linear transformation

Diagonal square matrix
Characteristic polynomial of a square matrix or a linear transformation
Eigenvalues, eigenvectors and eigenspaces
Diagonalization

Solving a system of linear equations by the method of characteristic polynomials
Rank of a matrix
System of linear equations
Solving a system of linear equations
Solving a system of linear equations with parameters
Equivalent consequences of an invertible matrix

Echelon matrices, reduced echelon matrices, and solving a system of linear equations by Gauss Jordan elimination method
Echelon matrices
Reduced echelon matrices
The Gauss Jordan elimination method for solving a system of linear equations

Code	Title	Semester	Credits	Courses	Exercises	LAB
.S2ANAL	Calculus II	2	4	18	27	0

)epartment: IME - CCNE - CE

:ourse Objectives:

)ive the students the mathematical tools required for the advanced courses in their major such us olving differential equations, calculating multiple integrals and studying series.

:ontents:

Differential Equations: First-order differential equations, Second-order differential equations, Linear differential equations with constant coefficients.

Functions of Several Variables: Definition, Functions of two and three variables, Limit and continuity, Partial derivatives, Total differential, Types of coordinate systems.

Operators for Vector Analysis: Review of analytical geometry, Scalar field – Vector field, Gradient, LaPlacian, Divergence, Curl.

Multiple Integrals: Definition, Calculation of double and triple integrals, Applications: Mass of a heavy board, Center of gravity, Moment of inertia.

Sequences: Definition, Arithmetic and geometric sequences, Global behavior of a sequence, Limits, Equivalent and adjacent sequences.

Series : Definitions, Convergence, Divergence, Geometric series, RIEMANN series, Series with positive terms, Criterion of ALEMBERT and CAUCHY, Alternated series, Laurent series and Expansion of a function to a Laurent series.

Code	Title	Semester	Credits	Courses	Exercises	LAB
.S2DRHO	Human rights حقوق الإنسان	2	2	30	0	0

Department: CE - IME - CCNE - BC

Objectives:

Raising awareness of human rights and strengthening the links between humans.

Content:

Part I: Concept and context of human rights

1. The concept of human rights
2. The intellectual context of human rights
3. Historical overview
4. Resources and references

Part two: The content of human rights

1. Personal rights
2. Legal and legal rights
3. Political rights
4. Right to free thought (belief, expression, teaching, cultural participation ...)
5. Social and economic rights

القسم الأوّل :ماهية حقوق ألإنسان

1. **مفهوم حقوق** الانسان (حصة واحدة) : تعريف حقوق الانسان، التمييز بين الحق والحريّة، دول القانون، الديمقراطيّة.
2. **الإطار الفكري لحقوق الإنسان** (3 حصص): مدرسة القانون الطبيعي، نظرية العقد الإجتماعي المذهب الفردي، المذهب الإجتماعي.
3. **لمحة تاريخيّة حول حقوق الإنسان** (حصتان): الوثائق الانكليزيّة، الإعلانات الأمريكيّة، الإعلان الفرنسي، حقوق الإنسان عند العرب.
4. **مصادر حقوق الإنسان** (3 حصص): المواثيق العالميّة، مواثيق دوليّة خاصّة، المواثيق الإقليميّة المصادر الداخليّة.

القسم الثاني :مضمون حقوق الإنسان

1. **الحقوق الشخصيّة** (3 حصص): الحق في الحياة، الأمان من التعذيب، الحق في التنقل.
2. **الحقوق القانونيّة والقضائيّة** (حصتان): الحق في الشخصيّة القانونيّة، في حماية القانون، في اللجوء إلى المحاكم.
3. **الحقوق السياسيّة** (حصتان): حريّة الإجتماع، المشاركة في ادارة الشؤون العامّة، الإنتماء الى الدولة
4. **الحقوق الفكريّة** (حصتان): حريّة الإعتقاد، التعبير، التعليم، المشاركة الثقافيّة.
5. **الحقوق الإجتماعيّة والإقتصاديّة** (حصتان): الحق في الزواج وتكوين الأسرة، الملكيّة الخاصّة، مساواة المرأة مع الرجل، الضمان الإجتماعي، العمل، الأمومة، حقوق الطفل.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS2ELAN	Analog Electronics 1	2	4	15	18	12

Department: CCNE - IME

Objective:

The purpose of this course is to present the principle operation of active components in semiconductor and acquire the necessary knowledge of their characteristics to design and analysis of analog electronic circuits.

Contents:

Theory of semiconductors: Definitions: insulation, conductor, semiconductor, PN junction forward biased and reverse biased.

Diodes: Structure and physical phenomena, characteristics I (V), equivalent diagrams. Types of diodes and applications: rectifier diodes, zener, LED, Varactor.

Bipolar transistors: structure and physical phenomena, characteristics, DC analysis parameters, I V), AC analysis, variable small signal: equivalent circuits, hybrid parameters, and switching and distortion. Analysis of basic amplifiers using the principle of superposition and the basic laws of electricity.

The field effect transistor JFET and MOSFET: structure and physical phenomena, DC analysis characteristics: parameters, I (V) characteristics under varying small signal: Transconductance, equivalent circuits, distortion, switching types, applications of MOSFETs. Analysis of basic amplifiers using the principle of superposition and the basic laws of electricity.

Operational amplifier (OA): structure, parameters, real Op Amp, applications open loop and closed loop circuits, AO.

LAB Sessions:

Characteristics of the diodes – PN junction I(V). Applications of diodes: Rectifier, stabilization .... Characteristics of bipolar transistors I(V). Basic amplifiers: Common Emitter amplifier CE, common base amplifier CB, common collector amplifier CC.
Characteristics of JFETs I(V). Basic amplifiers: Common source amplifier SC, common gate amplifier GC and common drain amplifier DC.
Operational amplifier: Inverter, non inverter, addition, subtractor, integrator, derivative, comparators and Active Filters first order.

Code	Title	Semester	Credits	**Courses**	**Exercises**	LAB
LS2PRST	Structured Programming	2	4	12	18	15

Department: CCNE - BC

Objectives:

Deepen the algorithmic concepts of structured, modular programming. Introduce and manipulate different data structures

Contents

Functions

Arrays

Strings of characters

Pointers

Scope and Memorization Classes

Structures

Text and Binary Files

The Algorithmic Concepts are applied using C language.

LAB Sessions:

Functions, Arrays (one and multi-dimensions), Strings of characters, Pointeurs, portée-visibilité et classes de mémorisation, Structures, Fichiers textes et binaires.

Code	Title	Semester	Credits	Courses	Exercises	LAB
RINFL2100	Computer Networks I	2	5	21	21	18

)epartment: CCNE - BC

)bjectives:

ntroducing computer networks. Acquisition of general knowledge and skills on the transmission ıedia and digital encoding, modes and communication techniques, topologies and architecture of ıe networks, physical layer and data layer connections.

:ontents:

)verview (Introduction of the basics of networking terminology, bandwidth, throughput, Network ypes: LAN, MAN, WAN, SAN, network models: TCP / IP, Standards Organizations). 'ransmission media and digital encodings (Media types: coax, twisted pair, fiber optics, lectromagnetic waves, analog modulations, Data encoding: RZ, NRZ, NRZI, Manchester,)ifferential Manchester, nB / mB, ...). The methods and techniques of communication Communication modes: serial, parallel, synchronous, asynchronous, online and offline, 'echniques: multiplexing, demultiplexing, error checking,), the network topologies (Topologies: us, ring, star, mesh, The IEEE model, concept of access method). Architecture of computer etworks: OSI Architecture and TCP / IP. OSI: presentation of seven layers of the OSI model, :ncapsulation and decapsulation, the service primitives. TCP / IP architecture: Presentation layer, P addressing, presentation of the main protocols such as HTTP, DNS, FTP, Telnet, TFTP, :MTP...

.AB Sessions:

ıstalling a local network adapter. Installing a local network. Preparation and use of twisted pair ables of different types. Configuring TCP / IP Settings for a Network. Splitting a network into a ubnet. Use of "Ping and Tracert" and ARP commands. Installation of Ethereal and the "WinPcap 'ackage". Establishing a console connection with a Router or Switch. Sharing network resources.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS2STPA	Applied statistic and probability	2	4	18	27	0

)epartment: CCNE

)bjective:

nitiate the students to reasoning and to the usual statistical methods. The skills developed relate o the methods and tools of inferential statistics useful to the engineer. This course also presents in letail the main notions and methods of probability (probability of events, moments law of random 'ariables, Conditioning and regressions, Transforms of the random variables, Gaussian laws). The ast chapter is dedicated to Markov chains because of their importance in a large number of pplications.

Contents:

)escriptive Statistics

Introduction: Two variables statistics ; Discrete variables (representation, fit, characteristics). Continuous variables (representation, characteristics and properties).

Combinatorial analysis and Probabilities

Elements of combinatorial analysis: counting, p-lists ; Concepts of random experiment. Definition of probability, conditional probability, Bayes' formula, Independence in probability.

Random variables

Discrete random variable on a finite sample space : definition, probability distribution, cumulative distribution function, characteristics and properties ; Discrete random variables on an nfinite sample space ; Continuous random variables: definition, Probability density function, Cumulative distribution function, characteristics and Properties.

Probability distributions

Finite discrete probability distributions (Uniform, Bernoulli, Binomial): definitions and characteristic values ; Discrete probability distribution on an infinite sample space (Poisson, Geometric...): probability distribution of a continuous random variable (normal, exponential...), lefinitions and characteristic values ; Random variable over IR2: Definition, probability law Marginal probabilities), sum and difference of 2 random variables.

Estimation of parameters

Estimation by method of moments ; Estimation by method of maximum likelihood ; Properties of estimators: unbiased and biased estimators, consistent estimators. Asymptotic law of estimators.

Markov chains

Constant vector of a matrix, probability vector, stochastic matrix and regular stochastic matrix ; Discrete Markov chains : definition, transition matrix, transition diagram, the n step transition natrix, probability vector of order n, stationary distribution of regular Markov chain process, absorbent state. ; Continuous Markov chains: Definition, intensity of transition, equilibrium equations, process of birth and death, waiting lines models M/M/C.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS2THSI	Signal Theory	2	3	15	15	0

)epartment: CCNE

'rerequisites: Applied-calculus

)bjectives:

'resentation of methods and techniques of signal processing and their application to physical ieasurements.

:ontent:

)efinitions and general properties of signals: Continuous signal, Deterministic signal and ?andom signal, Amplitude and time transformations of the signals, basic signals (Unit step unction, unit impulse function……). energetic classification, representation and properties of ystems (with memory and without memory, causality, stability, linearity and time variant).

.TI Systems (Linear time-invariant systems): Impulse response, response to an arbitrary input, ıroperties of the convolution, step response, properties of continuous- time LTI systems causality, stability,), systems in cascade and parallel.

'ourier Series: Introduction and demonstration of Fourier series, applications on different ignals (Square, rectangular, saw- tooth, half- wave….), spectral representations (amplitude and)hase) and applications on different types of filters.

'ourier transform: Definition and properties of the Fourier transform frequency response of LTI ystems, circuit applications and Parseval theorem.

?andom signals: Probability (Random variable, Mean, variance, ….), random process, stationery ınd ergodicity, correlation and power spectrum, transmission of a random process through a inear system ,Gaussian noise ,white noise ,and white noise with limited spectrum.

Semester 3

Semester 3						
Code	Course	ECTS	CM	TD	TP	Total
LS3ANAL	Calculus III (IME-CCNE)	3	12	18		30
LS3BDDR	Relational Database I (CCNE-BC)	4	15	15	15	45
LS3ELAN	Analog Electronics II	4	15	18	12	45
LS3ELNU	Digital Electronics II	4	15	18	12	45
LS3LAOO	Object Oriented Language	4	15	15	15	45
LS3REEW	Wide Area Network	4	15	15	15	45
LS3REIN	Computer Network II (CCNE-BC)*	4	12	15	18	45
LS3STDO	Data Structure (CCNE-BC)	4	12	18	15	45
LS3TEAN	Analog Communications	4	15	15	15	45
Total	8	31	114	132	99	345

Code	Title	Semester	Credits	Courses	Exercises
LS3ANAL	Calculus III	3	3	12	18

Department: IME - CCNE

Give the students the mathematical tools necessary to follow the basic or specialization courses, as part of the formation, such as: use of mathematical tools for 3EA applications.

Objectives:

Give the students the mathematical tools necessary to follow the basic or specialization courses, as part of the formation, such as: use of mathematical tools for 3EA applications.

Content:

Fourier series: Trigonometric series, Calculation of coefficients, Expansion to Fourier series: Case of 2Π-periodic functions and T-periodic functions, Complex form of the Fourier series, Applications.

Fourier transform: Definitions, Fourier transform of the usual functions, Properties, Applications.

Laplace transform: Definitions, Laplace Transform of usual functions, Properties, inverse Laplace Transform, Applications.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS3BDDR	Relational Database I	3	4	15	15	15

Department: CCNE - BC

Objective:

n this course we are interested in the computerization methodology of companies starting from he requirements to lead to the data models. The goal is to be able to design, create, administer, nanipulate and query a database. Thus in this course, we describe the concept of the database and he DBMS (Database Management System). We are mainly interested in databases and RDBMS of the "Relational" type. The focus is on designing a good schema of a relational database and using DBMS to implement and exploit it.

Contents:

After a recall about the general architecture of an information system and the different types of organizations and file operations, we describe the advantages of using a database. According to he ANSI/SPARC architecture, we define the different levels of a database description conceptual, logical and physical). Then we present the Entity-Relationship model (Merise model) which lead to establish a conceptual data model based on the needs expressed by the client: we nsist on the design of an optimized database schema (functional dependencies, theory of normalization, ...). After that, we describe how to transform an Entity-Relationship model to a Relational model. Finally, we treat of the data manipulation in the Relational model by presenting elational algebra as well as the SQL language.

Lab sessions:

Environment. Design of a relational database: modeling and implementation of an entity-elationship model. Manipulating databases using SQL queries.

DBMS used: Microsoft Access, SQL server

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS3ELAN	Analog Electronics II	3	4	15	18	12

Department: CCNE

Prerequisite: Electricity, Analog Electronics I

Objective:

The aim of this course is to study and analyze the various active circuits used in telecommunication chains for the purpose of signal processing, such as amplifier circuits, oscillators, and filters and mixing circuits.

Contents:

Reminder on the active components: Diodes, Bipolar transistors, BJT transistor, FET operation in high frequency, equivalent scheme RF.

Amplifier circuits: frequency response (bandwidth, cut-off and transition frequencies), power amplification, class A amplifier, class B (push-pull) and feedback amplifier.

Passive filter synthesis: Filter types (low-pass, high-pass, and bandpass), transfer function, order, normalization, cut-off and normalization frequency, template, and transfer from the low-pass prototype to the high-pass and bandpass, polynomials of Butterworth, Chebychev and Bessel, synthesis method of a filter from a given specification.

Active filters: Amplifier-based filter, first order and second order, low-pass, high-pass and band-pass filter.

Oscillator circuits: oscillation conditions (Barkhaussen law), oscillation frequency and output spectrum, Pushing, Pulling, types of low frequency oscillators (Colpitts oscillator, Hartley, Wien bridge, phase shift), and Phase locked loop (PLL).

Mixers: principle of operation, nonlinearity of the active component used, types: modulators, multipliers, transposers, study of the output spectrum, applications.

LAB Sessions:
HF amplifier, frequency response, Oscillators Colpitts, Hartley, Wien bridge, Passive filters; Active filters, Mixers, Spectral analysis of signals with the Fourier transform.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS3ELNU	Digital Electronics II	3	4	15	18	12

)epartment: CCNE

'rerequisites (enrollment and attendance): Digital Electronics 1

)bjectives:
Jnderstand the functional role of different types of buses and their digital signals in a computer nd processing circuits capable of delivering these signals, describe the main characteristics of ogic families. Understand the principle of operation of converters and their roles. Understand and lescribe the structure and organization of different Analog types of memory. Present the rchitecture of the microprocessor.

Content:

The multivibrators: monostable, astable, Schmitt trigger, signal generators, pulse generators, etriggerable monostable multivibrator, built-in timer 555.

C logic families: Terminology of CI digital parameters. TTL family - totem pole output stage, pen collector output, tristate output. ECL family. MOS ICs. Basic characteristics of digital ircuits.

Analog-Digital and Digital-Analog converters: weighted resistor DAC, ladder and inverted adder DAC, and characteristics. Digital ramp ADC, ADC by successive approximations, flash or arallel ADC, three states ADC, sampling and storage circuitry, digital voltmeter.

Memory devices: terminology: cell, word, capacity, and address, read and write operations, ccess time, memory: volatile, random access, sequential access, RAM, ROM, mass, static levices. Operation of a memory, architecture and synchronization of ROM memories, types of ROM memories, applications and programming, test of ROM memories, random access memory rchitecture, static random access memory (SRAM), dynamic (DRAM), sequential memory.

Microprocessor: address, bus, data memory, program memory, introduction to the assembler.

LAB Sessions: Monostable with OP Amp and 555 IC. Astable with OP Amp and 555 IC. Schmitt trigger, generating of square wave signals. Digital to Analog Converter. Analog to Digital Converter. Characteristics of logic gates: open collector, totem and tristate circuits. RAM nemory. EPROM memory with tristate ports.

ode	Title	Semester	Credits	Courses	Exercises	LAB
.S3LAOO	Object Oriented Language	3	5	15	15	15

)epartment: CCNE

'rerequisites (enrollment and attendance): Structured Programming

)bjective: Master the basic principles of object-oriented programming in C #. This course is an ntroduction to object-oriented programming. Key topics include classes vs. objects, ncapsulation, inheritance, and polymorphism. Students will understand object-oriented rogramming principles and apply them in the construction of C# programs.

:ontents:

3asics: Predefined primitive data types. Variable declaration. Structure of a C # program. The ype String. Conversions between numbers and strings. Satndard Input / output. Operators. :ontrol structures. Arrays. Enumerations. Parameter passing (by value, or by reference).

:lass and object: The reference types. Difference between primitive variable and reference 'ariable. The notion of a class. The notion of an object. Members of a class: fields and methods. :ncapsulation and data hiding: visibility of a member (public, private, protected). Basic methods n a class: Constructor, multiple constructors, properties (get and set), the ToString method. nstantiation. Methods overloading. Static fields and methods. Conversion between simple types nd object types (outboxing, inboxing). Exception handling (try, catch, finally, throw). nheritance. Polymorphism. Method overloading vs method overriding. Abstract classes and nethods. Multiple inheritance. Interfaces. ArrayList. Operator overloading. Indexers.

.AB Sessions:

Presenting of Visual Studio environment and C# configuration.
Development of programs with control statements. Practics on One-dimensional and two-dimensional arrays.
Creation of classes and implementation of constructors.
Creation of classes with instance methods, static methods and recursion.
Exception handling
Creation of classes, interfaces, sub-classes and and management of ArrayList collection.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS3REEW	Wide Area Network	3	4	15	15	15

)epartment: CCNE

'rerequisites (registration and attendance): Computer Networks I

)bjectives: Mastering the technologies, protocols and standards of WANs.

:ontents:

VAN technologies: equipments, standards, packets switching and circuits switching WAN echnologies, Comparison of current WAN technologies. The TCP / IP architecture: the layers of he TCP / IP model and features of each layer. The datalink layer, and HDLC and PPP protocols. The network layer and IP addressing, subnetting, VLSM and CIDR techniques, private addressing nd public addressing. The evolution to IPV6, addressing, comparison between IPv4 and IPv6 'ersions. Dynamic addresses management with RARP, BOOTP and DHCP. DNS, ARP, and CMP protocols, NAT and PAT functions. The IP routing: static routing, dynamic routing, listance vector routing protocols, links state routing protocols, characteristics of IGRP, RIP,)SPF and EIGRP. The transport layer and the application layer of the TCP / IP model: functions)f the transport layer, flow control, connection between peer systems, windowing, the transport ayer protocols, header formats of TCP and UDP segment, and main protocols of the TCP / IP pplication layer: functions of well-known applications of TCP/IP model. X25 networks: 'rinciple, virtual circuits, different types of packets. The frame Relay: general architecture, Frame Relay technology, Frame Relay topology, virtual circuit, congestion control. The access networks: :DSL (different systems - ADSL, HDSL, etc. principle, speed, distance,), etc.

.AB Sessions:

P addressing, DHCP, NAT, PAT, ARP. Frame Analysis. Configuring access lists. Static and lynamic routing. Configuring a Frame Relay network.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS3REIN	Computer Networks II	3	4	12	15	18

Department: CCNE - BC

Prerequisites (registration and attendance): Computer Networks I

Objective:

Technologies, protocols and standards of LAN and TCP / IP architecture.

Content:

TCP / IP architecture: PPP and HDLC protocols, the network layer and IP addressing, structure of IPv4 addresses. VLSM and CIDR techniques, subnetting, private and public addressing. The evolution to IPV6 addressing, comparison between IPv4 and IPv6. Dynamic addresses management principle with RARP, BOOTP and DHCP, NAT and PAT. DNS, ARP, and ICMP protocols. IP routing: Static Routing, Dynamic Routing, distance-vector routing protocols, link-state routing protocols, Characteristics of IGRP, RIP, OSPF and EIGRP. The transport layer: functions of the layer, header formats of TCP and UDP segments. The TCP / IP application layer: functions and well known applications of TCP / IP model.

LANs. Ethernet, IEEE 802.3: Basics of Ethernet technology, access method and principle of CSMA / CD, frame formats, Errors and Ethernet collisions, Synchronization, the BEB algorithm, differences and similarities between the versions 10BASE5, 10BASE2, 10BASE-T and recent versions of Ethernet. The evolution of Ethernet switched Ethernet, Fast Ethernet and Gigabit Ethernet. Interconnection of local networks: interconnection equipment (repeaters, Hub, Switch, Bridge, Router), Functions of bridges, the protocol STP (Spanning Tree Protocol). The Virtual LAN, VLAN Benefits, the main types of VLAN, ISL and 802.1Q protocols, the VTP protocol. Introduction to wireless Networks, mainly the wi-fi IEEE 802.11 protocol.

Lab sessions:

IP addressing, DHCP, NAT, PAT, ARP. Configuring access lists. Static and dynamic routing. Data unit Analysis at MAC level, LLC, HDLC, IP and TCP / UDP levels. Local networks interconnection. Configuration of Switchs, STP, VLAN. WLAN: Basic configuration of a wireless network.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS3STDO	Data Structure	3	4	12	18	15

Department: CCNE - BC

Objectives:

Master the Algorithmic concepts of Structured and Modular Programming. Introduce and manipulate various data structures.

Content :

- Recursion.
- Performance Analysis and Optimization - Complexity.
- Modular Programming.
- Sorting.
- Abstracts Data Types: Linked Lists (simple, circular, and double) Stacks and Queues.
- Trees.

The Algorithmic Concepts are applied using C language.

LAB Sessions:

Recursion, Multi-Files Program, Sorting, Linked Lists, Stacks and Queues, Trees.

Code	Title	Semester	Credits	Courses	Exercises	LAB
S3TEAN	Analog Telecommunications	3	4	15	15	15

)epartment: CCNE

)bjectives:
ntroduction to telecommunications systems with the processes of modulation in transmitters and hose of demodulation in receivers. Description of the transmission chain: transmitters and eceivers structures.

:ontent:
ntroduction: example of the general structure of a transmission system by electromagnetic wave, epresentation of the signals (spectral and temporal); example of the data signals, audio and video. nterest of the modulation, Fourier series and Fourier Transform.

'he Amplitude Modulation AM: characteristics of the AM modulation, mathematical expression of an AM modulated wave and its spectral composition, relationship of power, modulation nethods: modulation with multiplication and addition modulation and nonlinear amplification. 'he different types of AM modulation: with carrier, suppressed carrier (DSB), single sideband SSB), vestigial sideband (VSB). Demodulation processes: envelope detection, synchronous letection. Receiver with direct amplification and super heterodyne receiver, receiver properties: ensitivity, selectivity, stability, fidelity, signals to noise ratio.

'he Frequency Modulation FM: principle, mathematical expression of an FM modulated wave, nodulation index, Bessel function and spectrum of an FM signal, power, generation of FM ignals : direct method and indirect method (Armstrong modulator), examples of an FM ransmitter (direct and indirect), different types of demodulation: quadrature detector, phase ocked loop (PLL), general structure of an FM receiver. Comparison of AM and FM modes.

'he Phase Modulation PM: Description, mathematical function, phase deviation and frequency pectrum of a signal PM, relationship between PM and FM, phase modulation with phase shift ircuit (Armstrong circuit), comparison of AM and FM

Inalog pulse modulation: principle, pulse amplitude modulation PAM: principle, sampling, pectrum of a PAM signal, PAM demodulation. Temporal pulse modulation PTM, both types of nodulation PTM: PWM and PPM; principle, structure of the transmitter, the receiver structure, nultiplexing of TDM signals: PWM and PPM, example of a multiplexer, demodulation.

.AB Sessions:
\M modulation, transmission and reception.
)SB and SSB modulation, transmission and reception.
'M modulation, transmission and reception, PLL circuit.
\M modulation, form of signals, phase and frequency deviation.
'ulse modulation, PAM, PWM and PPM.

Semester 4

Semester 4						
Code	Course	ECTS	CM	TD	TP	Total
S4ATGL	Computer Software Engineering	4	15	15	15	45
S4AULI	Linear Control (IME-CCNE)*	4	12	15	18	45
S4CIPR	Programmables Circuits (IME-CCNE)	4	12	15	18	45
S4EXCO	Communication Skills (CE-IME-CCNE-BC)	2		15	15	30
S4LITR	Transmission lines	4	15	18	12	45
S4RELL	Local Area Network	4	15	15	15	45
S4SYEX	Operating Systems (IME-CCNE)	4	15	15	15	45
S4TENU	Digital Communications	4	15	15	15	45
S4TRNS	Digital Signal Processing*	4	12	12	21	45
Total	8	30	99	120	126	345

Code	Title	Semester	Credits	Courses	Exercises	LAB
4ATGL	Computer Software Engineering	4	4	15	15	15

Department: CCNE

Prerequisites (registration and attendance): Algorithms and Programming, Data Structure, Object-Oriented Programming

Objectives:

Master the event and graphic programming. Design and develop applications with graphical user interfaces. Manipulate physical media supports (drives, disks, files, databases, messaging ...) through graphical interfaces.

Contents:

Recap about information systems. The functionalities of a multi-user application. Step of a program (coding, compilation, execution...). Life cycle of an application (design, development, integration, production, maintenance ...). The different programming models (structured, modular, object oriented, services ...). Event and graphic programming: programming model; exception handling, graphic controls (Input fields, Selection boxes, Lists, Timer, Containers, Tree View, Dates (DateTimePicker), image management, ...), Menus, Toolbars, Dialog boxes; Events definitions, generation, management, ...); design, development and use of new controls; Manipulate an interface with multiple windows (Multiple Document Interface), Manipulate physical media supports (drives, disks, files, databases, messaging, ...).

LAB Sessions:

Environment. Generation and formatting of a graphical interface. Event Management, Menus, Toolbars and Dialogs. Creations of the new graphic controls. Link with a physical media supports file drives, disks, files, databases …). Using DLLs and API. Development of an advanced application. Mini Project on a concrete application and reinforcing the points mentioned in the Lab.

Code	Title	Semester	ECTS	Lecture	Exercises	LAB
LS4AULI	Linear Control	4	4	12	15	18

)epartments: IME - CCNE

're-requisites: Machines and Electrical Actuators I, Calculus III

)bjectives:

- Functional analysis and modeling of a control system.
- Characterization of a control system.
- Evaluation of the performance of a control system.
- Implementation and adjustment of PID (proportional–integral–derivative).
- Be able to characterize and model a linear control system.
- Know how to do a functional analysis of a control system.
- Be able to evaluate the performance of a control system.
- Know how to operate a PID controller.

:ontents:

ntroduction to linear control system: (control and regulation).

Modeling of linear systems (1st and 2nd order). Modeling in State Space.

)pen- loop and Closed-loop Control Systems. (Bode, Nyquist and Black diagrams).

Response and performances of feedback loop systems (stability, static and dynamic accuracy…).

'ID control – ON/OFF control.

.AB Sessions:

- ✓ Introduction to Matlab/Simulink
- ✓ Time and frequency analysis with Matlab
- ✓ Block diagram implementation in Simulink
- ✓ Example of study : DC motor (Modeling + speed control)
- ✓ Practical implementation of Level and temperature regulation system
- ✓ Speed and position control of a DC motor on a real system.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS4CIPR	Programmable Circuits	4	4	12	15	18

)epartment: CCNE - IME

're request (registration and attendance): Basic Computer, Digital electronics

)bjectives:

Knowledge of the general architecture of Microprocessor and Microcontroller. Ability to program nemories and programmable electronics circuits. Design and construct a system based on rogrammable electronic circuits; low-level programming language.

Contents:

The memories: ROM and RAM memory, Block diagram of a memory, Timing diagrams in nemory for read / write operation, Classification of memories.

Architecture and operation of a microprocessor: Structure of computing, Organization of the entral memory, Description of a microprocessor, Microprocessor operation, stack, interrupts, nputs / outputs.

Microcontrollers: Families of microcontrollers, typical architecture of a microcontroller.

Families of Microcontrollers: PIC16F84 - PIC16F877, 874,876

- **Programming of PIC16F84:** General architecture, organization of memory, read and write in EEPROM, I/O Ports, Timer0 module, Addressing and instructions set. Programming assembly language.
- **Programming of PIC16F877:** Organization of memory, Timer0, Timer1 and Timer2 modules, CCP module, Analog/digital convertor, USART.

LAB Sessions:

The practical work will be organized as follows: MPLAB, Proteus and Arduino IDE; Verification of the operation of the program on the test board: Digital inputs/outputs, 7-segments display, nterruption, Timer0, analog to Digital convertor and CCP Module.

Program an Arduino Microcontroller platform: Basic experiment with Arduino Uno and LEDs/Switches; Analog Inputs/Outputs devices (Potentiometer, PWM); Serial Communication; imulation of Arduino platform in PROTEUS.

Code	Title	Semester	Credits	Courses	Exercises	LAB
.S4EXCO	Communication Skills	4	2		15	15

)epartment: CE - CCNE - BC - IME

)bjectives:

Initiate students to different situations of communication which might be encountered in professional environments.
Use correctly and effectively written and oral expression
Using English as a necessary tool in expression and communication.

:ontent:

Generalities:

Definition of communication elements: transmitter- receptor-support.
The problems of expression and communication: situations and necessities.
Elements of communication: transmitter- receptor-support. Typology of people and its impact on communication: elements of psychology, adaptation of communication according to the conversational pattern. Organization and preparation to a situation of communication (written or oral): documentary research, choosing and preparing the support, spatiotemporal definition.

Written expression:

The scientific report: types: training report, degree project, and report.
Steps to write a scientific report (subject, bibliography, plan...)
Objectivity/subjectivity: objective elements and personnel point of view.
The form of the scientific training.

The CV: objectives of CV, its relation with the LM.
Form and content of CV; balance between formalism and personalization.
Different situations: a candidacy to training, to a job, to a university.

The motivation and cover letter:
The ML objectives and its link with the CV.
Form and content of the ML, balance between formalism and personalization.
Different situations: a candidacy to training, to a job, to a university.
Others: press release, advertisement.

Oral expressions:

The presentation: to present himself to the audience / to present himself to another person, talk about himself/ to explain a real subject. **Types:** presentation of work experience, presentation of degree project, presentation of a project, presentation of a report (activities report, balance sheet)
Problems: report to the public, used support, specific knowledge of the tool PowerPoint.
Discussion / debate: characteristics of debate: to outline ideas, answer questions, to argue.
Interview: characteristics of the interview: types of interview: hiring, training.
Negotiation: characteristics of negotiation.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LDTRL4100	Transmission Lines	4	4	15	18	12

)epartment: CCNE

're-requisite (registration and follow-up): General Electricity

)bjective:

'he objective of this course is to study transmission lines and their applications. The types of ines, propagation modes and principal parameters…

'ontent:

'ropagation of electromagnetic waves in free space: Components of the electromagnetic field nd vector representation in the space, review of Maxwell equations, Helmholtz equation, lectromagnetic power…

'ransmission line and TEM mode: Definition, propagation equation in sinusoidal regime, haracteristics of the TEM mode with losses and lossless, velocity and propagation delay, haracteristic impedance, matching, pulse signals, interference.

'losed metal wave guides: Structure, advantages and defaults, propagation equation, types and ropagation modes, fields, characteristic equation, guided wavelength, principal parameters...

.AB Sessions:

Measurements and characterization of a coaxial line. Measurements with pulse signal. Measurement and characterization of Unshielded Twisted Pair. Measurement and simulation of natching characteristics. Measurement over wave guides. Loads measurements.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS4RELL	Local Area Networks	4	4	15	15	15

)epartment: CCNE

'rerequisites (registration and attendance): Computer Networks I

)bjectives:
/lastering the technologies, protocols and standards of local networks - wired LAN and wireless.

:ontents:

.AN architecture. Ethernet, IEEE 802.3: Basics of Ethernet technology, access method and rinciple of CSMA / CD, frame formats, Errors and Ethernet collisions, Synchronization, the 3EB algorithm, differences and similarities between the versions 10BASE5, 10BASE2, 10BASE- and recent versions of Ethernet. The evolution of Ethernet: switched Ethernet, Fast Ethernet and ligabit Ethernet. Token Ring networks: Access method, principle, Token Ring Frame Format,)ifferential Manchester encoding, priority management, ETR (Token Early Release). nterconnection of local networks: interconnection equipment (repeaters, Hub, Switch, Bridge, Router), Functions of bridges, switching modes, the protocol STP (Spanning Tree Protocol). The /irtual LAN: Define VLAN, VLAN advantages, the main types of VLAN, ISL, 802.1Q and VTP rotocols. FDDI networks: principle, access method: timed token, FDDI frame format, optical ransmission and fiber types, and data encoding: the NRZI codes and 4B / 5B. Introduction to vireless networks WPAN, WLAN, WMAN and WWAN. Wireless LAN, IEEE 802.11: rotocols, physical layer, MAC sublayer and access methods, 802.11 frame format, QoS and ecurity, WEP and WPA protocols.

.AB Sessions:

.ocal networks interconnection. Configuring a Switch, STP. VLAN. Wireless LAN: Basic onfiguration of a wireless network, setting up a secure wireless network. Analyze and roubleshoot a wireless network. Secure data transmission via a wireless local area network using WiFi (WPA).

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS4SYEX	Operating Systems	4	4	15	15	15

Department: CCNE - IME

Prerequisite (registration and attendance): Algorithm and Programming, Data Structure

Objective:

ntroduction to operating systems. Installation and using of Linux system. Creation of Shell cripts. Acquisition of programming techniques based on semaphores related to real time pplications and interprocess communication.

Contents:

Overview:

Main functions of operating system, different types, evolution of different structures, architecture.

Basic concepts (Process, Synchronization, Memory management, Input/Output management);

Process management and interprocess communication:

Process planning, case study: Planning under Linux and Windows

Techniques of semaphores, Semaphores, synchronization, process communication, case study: Linux: (fork () and exec (), signals).

Dead Lock process.

Real time applications: Automatic piloting of an aircraft, machining of rough parts in an industrialized chain, ABS braking system in cars.

Classic Problems of synchronization: producer/consumer; readers/writers;

Memory management: main functions, virtual memory, base registers and limit, paging, segmentation, reallocation and replacement algorithms, Linux and Windows case study, Intel Pentium case study (Segmentation with paging).

LAB Sessions:

Installation of Unix; User commands; Users management, Privileged commands; File management – Access modes; Process management - redirection; Process communication through tubes; Unix-based Office Text and Graphics; Creation of processes; Application semaphore; script programming language; Administration.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS4TENU	Digital Communications	4	4	15	15	15

)epartment: CCNE

're-requisite (registration and attendance): Statistics and Probabilities, Signal Theory, Analog :ommunications

)bjectives:

1. Study qualitative and quantitatively the problem of digital communications
2. Evaluate and compare the processes of digital modulations
3. Evaluate the performances of complete systems of digital transmissions

:ontent:

)igital Modulation of analog signals: Pulse Coded Modulation PCM, Sampling, Uniform and .on-uniform quantization, Compression laws: A-law and μ-law and Delta modulation.
:ource and channel coding: Information theory, Entropy, Hoffman coding, Generalities on hannel coding and errors correction: Hamming code.
3ase-Band transmission, propagation channel limitations: Noise, Inter Symbols Interference (ISI), :ye pattern, Probability of error and Equalization.
3and-Pass transmission: Analog Modulations of digital information ASK, PSK, FSK, MSK, GMSK, QAM, Demodulation and frequency synchronization, Constellation diagrams and 'robability of errors.
3eneralities on Multiple Access Techniques: FDMA, TDMA, CDMA and OFDM.

.AB Sessions:

:ampling and quantization, PAM modulation, PCM modulation and Delta modulation.
:imulation of a digital communication system (Different types of base-band coding, Eye patter nd Noise).
3and-Pass transmission, spectra, ASK – FSK and PSK modulations.
:mall project.

Code	Title	Semester	Credits	Courses	Exercises	LA
LS4TRNS	Digital Signal Processing	4	3	12	12	21

)epartment: CCNE

'rerequisites (Registration and Attendance): Algebra, Applied Analysis

)bjective:

Jnderstanding digital signal processing techniques.

:ontents:

)iscrete signals and systems: Discrete particular signals (unit sample, unit step, rectangular ...), Transformations (according to time and amplitude), characteristics, system (causality, time nvariance, linearity and stability), convolution, and properties of a LSI system.

)iscrete Time Fourier Transform (DTFT): definition and properties of the discrete time 'ourier transform, frequency response of a LSI system.

-transform: definition, properties and convergence region, development in series and in partial unction, System and characteristics of a LSI system (causality and stability).

)igital filters (Recursive and non-recursive): Organization of a digital filter, classification and haracteristics (FIR and IIR), structure, frequency response, method of synthesis of FIR filter by 'ourier series, window method.

AB Sessions:

The Matlab enviroment
Matlab Programming
Creating your first Matlab script, the Matlab editor, Scripts vs. functions
Controlling program control flow
Analyzing data

Removing and fixing invalid data, Fitting data, Error handling,

saving and loading data:

To/from Matlab workspace, To/from text or binary files, To/from Excel, To/from a webpage
Visualizing data
displaying results, 2D and 3D plot, preseting data tables
Signal generation
Signal filtering using FIR, Signal filtering using IIR
Signal filtering using FDATOOL for both FIR and IIR

Semester 5

Semester 5						
Code	Course	ECTS	CM	TD	TP	Total
_S5ADRE	Network Administration	4	15	15	15	45
_S5ANGL	Frensh (CE-IME-CCNE-BC)	2		30		30
_S5DEWE	Web Development (Client side)	4	15	15	15	45
_S5MITE	MicroWaves and Teledetection	4	12	18	15	45
_S5PRVH	VHDL Programming (IME-CCNE)	4	15	15	15	45
_S5PRAN	Antena and Propagation	4	15	15	15	45
_S5SYOP	OptoElectronics Systems	4	15	15	15	45
_S5WLES	WLAN and Securitry	4	15	15	15	45
Total	8	30	102	138	105	345

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS5ADRE	Network Administration	5	4	15	15	24

Department: CCNE

Prerequisites: Networks LAN

Objectives:

The objective of network management is to allow students the task of ensuring the security administrator, to conduct a risk analysis, design safety regulations and install the appropriate safeguards

Contents:

UNIX Network Administration: The function of administration and administrator tasks, computer systems architecture (recall), features of the UNIX system, the main services of the nternet, orders and administrative files, graphical administration tools, security in unix. SQUID erver: cache concept, installation, and configuration files squid.conf. Firewall :: Introduction, concept of security, attack methods, filtering methods, kernel configuration using IP Firewall and use ipchains and iptables, Firewall original: Firewall configuration using ipfwadm (laws, rguments, categories , commands, parameters and types of ICMP Datagrams) of IP Firewall Chains: configuration of ipchains (orders, rules setting, scripts); Netfilter and IP Tables: comparison of ipfwadm, ipchains and iptables.

Network Administration in Windows: Concepts and infrastructure of Windows 2003 Advanced Server (Forest, Tree, Domain, and OR); Concepts Active Directory.

LAB Sessions:

Linux installation, configuration of network equipment. Serial link (SLIP and PPP). Installing and configuring a Web server. Installing and configuring an FTP server. Installing and configuring a mail server. Installing and configuring a DNS server. Squid. Firewall - Iptable.

nstalling the Windows Advanced Server + Active directory. Creating user accounts and their properties (username, password, profile, root directory, search for users ...) and anagement groups. File system NTFS and EFS, managing access permissions to files and directories. mplementation of the GPO (Group Policy Object) in a field, use of templates. Managing Hard Drives. Data protection against failure of Hard Drives (Backup and Restoring Data). Installation nd configuration services: DHCP, WINS, DNS, IIS, RAS. Installing and configuring a Web server and FTP. Network Security: IPSec and Public Key Infrastructure.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS5ANGL	French	5	2	-	30	

)epartment: CE - IME - CCNE - BC

)bjectives:

:e cours est conçu pour des étudiants ayant une formation générale ou technique. Ce cours léveloppe les capacités de lecture, d'écriture et de conversation aussi bien que l'amélioration de a prononciation et l'augmentation du vocabulaire. Une attention particulière est portée à la ecture et à la compréhension. L'objectif principal de ce cours est d'enseigner la compétence ommunicative, qui est la capacité de communiquer en Français en fonction de la situation, de 'objet et du statut des participants

:ontent:

.a première partie du cours est axée sur le vocabulaire essentiel, la lecture, la conversation et 'écriture : Portrait des étudiants, liste des détails des compétences personnelles, statut actuel,)arcours et responsabilités.

.a seconde partie est axée sur le vocabulaire technique, la discussion autour de sujets techniques, 'analyse de rapports techniques (articles, papiers de recherche, projets) et quelques activités de ommunication.

)bjective:

:nglish is a course designed for students with basic and technical major. This course covers the kills of reading, writing and speaking as well as improving pronunciation and building 'ocabulary. Particular emphasis is placed on reading and comprehension. The primary goal of this :ourse is to teach communicative competence, that is, the ability to communicate in English :cording to the situation, purpose and roles of the participants.

:ontent:

n this course, the first focused on: key vocabulary, reading, speaking and writing: Student 'ortrait, list all details of personal skills, present position, background and present esponsibilities.

'he second part focused on: technical words, discussion about technical topics, analysis of echnical reports (projects, articles, papers…) and communication activities.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS5DEWE	Web Development	5	4	15	15	15

)epartment: CCNE

'rerequisite (registration and attendance): Structured Programming, Data Structure

)bjective:

\cquire necessary notions and concepts to design and develop a Web application by using the *tyles* and managing client side events using *JavaScript* coding.

:ontent:

3rowser types and functions; Hypertext and hypermedia documents; the language (history, yntax, Structure, formatting, page layout, images, sound, color, hyperlinks, tables, frames, ;raphical controls and forms, reactive images (Map))

)ynamic HTML (positioning of objects, style sheets; Scripts)

:he Cascading Style Sheets CSS (Introduction and Role, as well as implementation of a style heet, link with the HTML document, Constitution of a stylesheet, Classes and IDs, group of tyles: legacy, nesting, conflicts between rules and stylesheet)

:he client side scripting language

:vent management

:he JavaScript core objects: string, dates and tables

Hierarchy of objects: the objects of the browser

'orms management

:imers

.AB Sessions:
HTML (performing a full page, using an HTML editor). Use of image manipulation software. Use)f multimedia software.
:SS Style sheets.
:lock; Calendar
'orm management: Unit and global controls on dialog boxes. Management of different types of :vents
\nimation of image using timers
*N*indows, Document objects.
)ynamic manipulation of content

Code	Title	Semester	Credits	Courses	Exercises	LAB
.S5MITE	Microwaves and Remote Sensing	5	4	12	18	15

)epartment: CCNE

'rerequisites (registration and attendance): Transmission lines

)bjectives:
'he objective of this course is to acquire the necessary knowledge to be able to analyze ıicrowave remote sensing systems, going from microstrip technology, passive devices and ıicrowave active devices.

:ontent:

ieneral information on teledetector systems: Frequency spectrum and microwave advantages, lassification and examples of remote sensing systems according to the required information, adar equation.

'ransmission lines: Introduction to open metal waveguides: microstrip technology and lammerstaad and Wheeler formulas, propagation parameters.

'assive microwave devices (dipoles, quadrupoles, hexapoles): Reminders of parameters elating to dipoles, definition of [S] parameters and application: isolator case, attenuator case, ıassive low-pass filter case, circulator case, etc....

)ctopoles or Couplers: [S] Parameters, characteristics of perfect and real directional couplers, ıanufacturing examples, Hybrid Tee and Magic Tee.

/licrowave active circuits: Active components used in microwave (Schottky diodes, Gunn liode, PIN diode, transistors ...). Features and microwave specificities of active circuits such as ıscillators, amplifiers and mixers.

/licrowave systems: RADAR Doppler, principle, block diagram, applications.

.AB Sessions:

: parts: Simulation and Practice
ìimulation on ADS software: Study of micro strip lines. Low-pass microwave filter in local and listributed elements. Study of a 3dB coupler and deduction of all its [S] parameters in module and ıhase, interpretation of results. Amplifier and its [S] parameters. Balanced amplifier and ıroadband adaptation validation

Jsing the microwave spectrum analyzer, Using the Analyzer and Generator set to measure the [S] ıarameters in transmission and reflection. Measuring bench in waveguides: guided wavelength, 'OS, variable attenuator characterization, impedance measurement, Doppler radar: validation of he Doppler Effect and parameters that influence the Doppler signal as speed. Radar-object listance, nature and constitution of the object.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS5PRVH	VHDL Programming	5	4	15	15	15

)epartment: CCNE - IME

're request (registration and attendance) : Digital Electronics I, Digital Electronics II, Circuit 'rogrammable I.

)bjectives

;tudy and implementation of basic systems and Microsystems adapted to the requirements of mbedded systems and control systems. Give the necessary basic knowledge and methodology to chieve correctly the conception of programmable logic device (FPGA, CPLD,) in VHDL. In rder to know how to implement the VHDL language, for the modeling, design and synthesis of ligital circuits system with the certainty of achieving a product that meets the specifications that nterfere with the electronics.

:ontent:

ntroduction, Design flow: Presentation of the FPGA, interest, evolution, field of application - :xplanation of the FPGA and CPLD architecture, the distribution of the elements and the ossibilities of exploitation of these different elements. Logic, embedded memory, clock blocks,)SP blocks, PLL, routing structure Design methodology, tools , etc.
:he VHDL language and structures: Introduction to the VHDL language - IEEE libraries - Design nits (entity, architecture, package, configuration) - Basic functions - Delay-VHDL data Types-Modular design - Modular decomposition (instantiation) - Signals and ports, processes of a signal, 'ariables vs. signals) - Concurrent and sequential instructions - Structural and behavioral lescription- GENERATE statement -Description Counter, register, divider frequency- loop, :xit, Wait, Assertion Statement- Functions and procedure - State machine (synchronous and synchronous) -Alias- Array- String- Record type- Memory.

.AB Sessions :
:he programmable device - FPGA (Altera DE2).
'ractical work and programming VHDL- Getting started with a simulation tool and a synthesis ool VHDL- Programming the FPGA module with the software Quartus and Modelsim.
)bjectives: Realize the synthesis of logical functions in VHDL, Simulate the behavior of the ystem and to validate the realization on the module (DE2 of Altera) - Programming of an SRAM 'PGA module. Study case: A pair work (each pair work has a different subject) with a part of pecifications analysis, a part of functional analysis, the synthesis of the functions using a VHDL lescription, global simulation then realization on the model for testing and validation.

Code	Title	Semester	Credits	Courses	Exercises	LAB
S5PRAN	Antennas and Propagation	5	4	15	15	15

Department: CCNE

Prerequisite (registration and assiduity) : General Electricity, Transmission Lines.

Objectives:

Master the antenna concepts: Radioelectrical characterization of different types of antennas: wire antennas, radiating apertures, arrays and printed antennas, receiver antenna and link budget. Calculate, simulate, fabricate and measure antenna prototypes.

Content:

EM wave propagation: Review of Maxwell's equations and wave equation, propagation modes of waves, polarization, Pointing vector.

Antenna in the transmission system: characteristic parameters of an antenna: gain, directivity, radiation pattern, input impedance, bandwidth, polarization. Reciprocity theorem. Antenna effective area. Thermal noise concept. Link Budget.

Wire antennas: Dipole, monopole over a ground plane, Yagi antenna, log-periodic antenna, helical antenna.

Radiating apertures: Horn, parabolic antenna.

Arrays: Linear and planar arrangement of antennas.

Printed antennas

LAB Sessions:

Simulation of wire antennas, Yagi antennas, horn and microstrip antennas. Fabrication and measurement of a Yagi antenna. Fabrication and measurement of a microstrip antenna. Measurement of array antennas characteristics. Measurement of horn antennas characteristics. Simulation and characterization of a radio coverage: indirect link (of FM type or others), direct link.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS5SYOP	Optoelectronics Systems	5	4	15	15	15

Department: CCNE

Prerequisites: Optics, Analogue Electronics 2, Digital Electronics 2

Objectives:

Operation of optical fiber telecommunication systems. Components and end circuits on ransmission and reception and master their use..

Content:

Electromagnetic Waves (EM) and light guiding by total internal reflection.

Optical fiber principles:

Types of optical fiber, Connections (connectors, splicing), Manufacturing, Bandwidth.

Optical emitter:

Light emission concept in Semi-Conductor (LED). Laser (Characteristic oscillation, resonance cavity).Modulation (internal and external, frequency modulation amplitude modulation and phase nodulation).

Optical receiver:

Photo Electric effect, Pin photodiode, APD (Avalanche photodiode).

Link budget analysis:
Attenuation and losses in a fiber optic, Intermodal and chromatic dispersion, Bandwidth limiting, Link margin and dynamic range.

Multiplexing: Time division multiplexing, Wavelength division multiplexing.

LAB Sessions:

- Introduction to the Emona Fotex optical fiber device,
- Optical fiber transmission (filter, light splitting, light combining),
- Full duplex communication,
- WDM (wavelength division multiplexing),
- Attenuation and losses in optical fiber,
- Project.

Code	Title	Semester	Credits	Courses	Exercises	LAB
LS5WLES	WLAN and Security	5	4	15	15	15

Department: CCNE

Prerequisites (registration and attendance):Computer Networks I, Wide Area Network, Local Area Networks

This course provides students with an introduction to the field of computer security and cryptography.

Contents:

General introduction to computer security.

Computer security terminology (threats, vulnerabilities, attacks, counter-measures ...). Security models and security services (confidentiality, availability, integrity, authentication, traceability, access control, non-repudiation). Security mechanisms (encryption, digital signatures, access control ...). Security policy.

Cryptography

Vocabulary for cryptography. A little history (Caesar Encryption affine Encryption, Vigenere Encryption, HILL Encryption, Vernam Encryption,). Symmetric and asymmetric encryption. The main cryptographic systems (AES, DES, RSA, El Gamal,). Security services and authentication. Hash functions, MAC, X509 certificates, digital signature, Radius, Kerberos.

Software and database security

Panorama of threats. Malicious software (computer virus, worm, logic bomb, Trojan, Spyware, Adware, ...). Databases and access control. Privileges and Roles. Encrypting databases.

Network and Internet security

Network attacks (ARP-Poisoning, IP spoofing, DoS, DDOS, ...), Honeypot, firewalls, IDS / IPS (Intrusion Detection & Prevention Systems), VPN (Virtual Private Network) : IPSec and SSL/TLS, HTTPS, security of Web applications (SQL Injection, Cross-Site Scripting - XSS, identity spoofing via cookies)

LAB Sessions:

Implementation in a programming language (such as the c language) the main encryption algorithms: classical (Caesar, ...) and modern (DES, AES, RSA, EL Gamal, blockchain). Using of steganography and fingerprint tools. Overflows and code injections. Analyzing and understanding of the PGP security protocol. Become familiar with the OpenSSL library. Implementing of a secure site with SSL (https). Using the Wireshark sniffer and the nmap vulnerability scanner and other security tools. Configuring Site to Site IPSec VPN Tunnel between Cisco Routers.

Semester 6

Semester 6						
Code	Course	ECTS	CM	TD	TP	Total
.S6STAG	Internship	6				
.S6PRFE	Senior Project (≈ 180 h / étudiant-projet)	12			180	180
.S6DRGT	General and Labor law (CE-IME-CCNE-BC)	1	15			15
.S6COEL	Electromagnetic Compatibility*	3	9	12	9	30
.S6TESA	Satelite Communication*	3	15	15		30
.S6TEFI	Fixed Telephony*	3	15	6	9	30
.S6TEMO	Mobile Telephony*	3	12	9	9	30
.S6ARCS	Client Server Architecture*	4	15	15	15	45
.S6PRRS	Network Systems Programming*	4	15	15	15	45
.S6PRTR	Real Time Programming*	4	15	15	15	45
Total	7	31	60	45	225	330

Code	Title	Semester	Credits	Courses	Exercises	Lab
LS6STAG	Internship	6	6	0	0	0

)epartment: CCNE - BC - IME - CE

nternship during semester 4:

)bjective:

'o allow a first contact with the professional world and a realization of the technical work under he supervision of a Specialist on the labor market.

'ontent:

)evelopment of company knowledge and the field of networks and telecommunications.

mplementation of the knowledge acquired at the University and benefit from practical training.

\ detailed report must be written and supported in front of a jury.

Internship during semester 6:

)bjectives:

'o allow the student to deepen his knowledge in the field of Computer Networks and 'elecommunications, to carry out studies in a professional environment.

'ontent:

)evelopment of corporate and professional knowledge in the public or private sector.

)iscover the trade by emphasizing the study component.

mplementation of the knowledge acquired at the University and benefit from practical training.

\ detailed report must be written and supported in front of a jury.

Code	Title	Semester	Credits	Courses	Exercises	Lab
LS6PRFE	Senior Project	6	12	0	0	180

)epartment: CCNE - BC - IME - CE

)bjectives:

)raw on the achievements of the various disciplines in the field of networks and elecommunications, in a simple project of a professional nature.

:ontent:

'roject subjects, characterized by their interdisciplinary dimension, are offered to students. A roject is proposed by a small group of students led by teachers. Students will apply the acquired echniques and will do the necessary additional research. A report will be written.

\ detailed brief must be written and argued before a jury.

Code	Title	Semester	Credits	Courses	Exercises	Lab
LS6DRGT	General and Labor Law	6	1	15	0	0

Department: CCNE - CE - IEM - BC.

Objectives:

nitiation to the law and the labor code so that the future graduate knows his rights and his duties luring the stages of the exercise of his profession.

Content:

ntroduction to the study of law

The legal rule: Definition - Characteristics - Sources - Principles - Classification.

The judicial process: The courts - Arbitration - The action - The modalities of the evidence.

The Contract and Liability: The Substantive and Formal Conditions of the Contract - Criminal Liability - Civil Liability: Contractual Liability, Tort Liability and Building Liability.

Labor Code:

Conditions of substance and form of the employment contract

Terms of the employment contract

Obligations of the employer and the employee

Warning

The holidays

Risk theory

Abusive termination

The National Social Security Fund CNSS

Code	Title	Semester	Credits	Courses	Exercises	Lab
36COEL	Electromagnetic Compatibility	6	3	9	12	9

)epartment: CCNE

'rerequisites: General Electricity, Analog Electronics I, Digital Electronics II, Programmable Circuits I.

)bjectives:
Knowing the areas covered by the EMC, Parasites and electronic disturbances, installation rules, dentifying problems and proposing their solutions.

Content:
ntroduction to EMC: definitions and vocabulary. Susceptibility and margins of compatibility. Relative units in db.

tegulation and standardization: European standard, Core and generic standards.

ntroduction to couplings: The six electromagnetic couplings. Differential mode and common iode. Common impedance Coupling. Capacitive card to chassis coupling. Inductive crosstalk Coupling. Capacitive crosstalk Coupling. Field to wire Coupling. Field to loop Coupling.

ources of disturbances: Disturbances at low frequencies. High frequency disturbances. Valuation of orders of magnitude. Unit conversion.

ffects on victims: Effects of disturbances on analog circuits. Effects of perturbations on optical eceivers. Effects of disturbances on digital circuits.

nalysis of disturbances. Coupling analysis.

ightning protection. The phenomenon of lightning. Conductive protection. Radiation protection.

ightning in conclusion ... Remedies in EMC. Reflexes in EMC troubleshooting. **hielding**: Reflection / Absorption. Shielding efficiency. Electrical continuity.

AB Sessions:

ffect of the layout of printed circuits on the behavior of assemblies (electronic printed boards).

imulation of Crosstalk in PCBs. Measurement of crosstalk in printed circuits.

lodeling the different coupling modes of electromagnetic disturbances on printed boards using M simulation software in transient and harmonic modes.

Code	Title	Semester	Credits	Courses	Exercises	Lab
.S6TESA	Satellite Communications	6	3	15	15	0

)epartment: CCNE

'rerequisites: Digital Telecommunications

)bjectives:

tudy and development of the techniques used in satellite communications.

:ontent:

ntroduction: technical launch and location of a satellite in geostationary orbit, the different ypes of orbits, evaluation of satellite communications, choice of orbit, longitude and latitude.

'echnical satellite communications between two earth stations: UPLINK and DOWNLINK, :equency domain, analog transmission, angle modulation, , interference, intermodulation, EIRP, :ee space loss, telephone channel, the baseband signal in real telephony, video channel and signal) noise ratio, noise temperature, OBO and IBO, digital transmission, encoding protection against rror messages, digital modulation and direct QPSR BPSR-differential PSK multi-level elationship between probability of error of transmission and energy per bit.

Aultiple Access: Techniques of communication through a satellite and several earth stations, affic engineering, technical modulation multiple access FDMA, TDMA, DS-CDMA direct equence, frequency hopping sequence FH-CDMA, the number of possible access by ommunication.

Code	Title	Semester	Credits	Courses	Exercises	Lab
LS6TEFI	Fixed Telephony	6	3	15	6	9

)epartment: CCNE

'rerequisites (Registration and Attendance): Algorithms and Programming, Analog :ommunications, Statistics and Applied Probabilities, Signal Theory.

'urpose:
ntroduction to the general architecture of a telephone network: Distribution, Switching and 'ransmission; Study of the various components constituting the telephone network; Network 'lanning based on mathematical probabilistic models; Acquisition of spatial and temporal witching techniques as well as multiplexing used in high-speed transmissions.

:ontent:

'elephony history, telephone switching, telephone network architecture, telephone network basic functions, organization and plans for a telephone network.

'elephone Device: Analog and Digital. Local loop, Ring tone, Pulse / Tone code generator,

)TMF dialing, Encoder / Decoder, Modem, PC interface.

'elephone Traffic: Mathematical Modeling, Lost Call Systems, Waiting systems, Erlang Curves,

Jetwork Sizing.

'unctions of a telephone switch, architecture of a connection network,Time and spatio-temporal switches TST, TSST, STS type.

'DH and SDH Transmission, Evolution of telephony.

.AB Sessions:

tructure of a telephone exchange (example MT20 / 25). Creation of local and external MICs, odes, bundles and routings. Subscriber and network management, Operation and maintenance of central office.

:onfiguring and Programming of a Central PABX.

'oice over Ip (Router Configuration- Network Time Protocol)

Code	Title	Semester	Credits	Courses	Exercises	Lab
.S6TEMO	Mobile Telephony	6	3	12	9	9

)epartment: CCNE

'rerequisites (Registration and Attendance): Analog Telecommunications. Digital 'elecommunications.

)bjectives:

Jnderstand the concept of a GSM cellular network: canonical architecture, protocol, operation, nd radio planning. Understand 3G and 4G systems.

:ontents:

ntroduction, Historical Overview, Principles of cellular network standards: second generation GSM) and third generation (UMTS). Satellite networks.
;SM Cellular Network Architecture: The mobile and SIM card, the radio subsystem BSS, The etwork subsystem NSS, the operating system OSS, OSI architecture.
;SM radio resource management: Structures of traffic, control and signalling channels. User ervices, Handing Over, Roaming. Security, establishment of a call from BS, Establishment of a all to BS.

:ellular Planning network: Concepts of cellular networks, cell division and frequency reuse, :affic study, calculation of co-channel interference, interference reduction methods.
:adio link engineering: Reminders of the concepts of propagation and antennas. Mobile radio hannel: amplitude distortion (fading), frequency distortion (Doppler), phase (delay spread). Link ;udget and Balancing a GSM radio link. Propagation models.

G: UMTS Standard: (Network, services, Interfaces), UMTS air interface (UTRAN), multiple ccess technique, authentication procedure, Physical/logical channels, handovers, Cell Search and ynchronization, Link budget example, load factor.

G: LTE network, Services and interfaces, Air interface, Reference signals, Multi carrier Aodulation, Cell Search Procedure,

.AB Sessions:

'lanning of GSM cellular radio coverage. Reception and sensitivity of the GSM system. Protocol nalysis in the Um interface. Using repeaters in GSM.

Code	Title	Semester	Credits	Courses	Exercises	Lab
.S6ARCS	Client Server Architecture	6	4	15	15	15

)epartment: CCNE.

'rerequisites (registration and attendance): Relational Databases, Web Client Development. :omputer Software Engineering.

)bjectives:

Aaster client-server event and graphic programming. Design and develop client-server pplications, Handle web services.

:ontent:

nformation systems; Client Server Client Architecture: Overview, Processing and Sharing Data; Gartner Group models, Panorama of different architectures. Application on the dynamic web lient-server: server scripts, object model, software components, sessions, dynamic graphical user nterfaces, event management, secure data access, transactions.

Veb Services: Simple Object Access Protocol (SOAP), Description of a Web Service, :omposition of Exchanged Messages, Creation of a Web Service, Creation of the Client \pplication and a Proxy.

.AB Sessions:

:nvironment. Development of an advanced client-server Web application: configuration, client cript, session concept, event management, secure data access, transactions, DLLs call, software omponent design, web services. Mini Project on a client-server application and reinforcing the oints mentioned in the Lab.

Code	Title	Semester	Credits	Courses	Exercises	Lab
6PRRS	Network Systems Programming	5	4	15	15	15

Department: CCNE.

Pré-requis (inscription et assiduité) : Algorithms and Programming, C language, LAN and WAN Networks

Objectifs:

The objective of the course is to study various techniques to permit the communication between processes in order to design and develop client/server applications.

Contenu:

Reminder of C language (structures and pointers, opening a file, reading and writing in a file,..)

Network reminder (OSI layers, hosts and services files, port numbers associated to services, IP addresses, hostname resolution).

Sockets and network programming in the Unix environment:

- Define sockets (concept, creation, address assignment, UDP or TCP protocol)
- Realization of client / server applications.

Communication between processes: management of processes, using of single tubes, named tubes and signals.

Communication between processes with system V IPCs: general principles of system V IPCs, message queues, shared memories and semaphores.

LAB Sessions:

Programming client / server applications using the different techniques studied (sockets, simple tubes, named pipes or shared memory). Synchronization between processes using semaphores and signals.

Code	Title	Semester	Credits	Courses	Exercises	Lab
LS6PRTR	Real-Time Systems	3	5	15	15	15

)epartment: CCNE

'rerequisites: Structured Programming (C language), Operating System: Linux

)bjective:

ntroduce students to the fundamental problems, concepts, and approaches in the design and nalysis of real-time systems. Study different problems in constrained systems (such as time, esource, and precedence constraints) and propose solutions.

:ontent:

. **Introduction**:

Definition of Real-time System RTS, Fast Computing vs Real-time Computing, Real time constraints, Classification and Characteristics of real-time systems, Critical and non-critical real-time system, Terminology (Event-Driven, Time-Driven)
Study of real-time task models, scheduling algorithms (RM, EDF, EDL ...) according to the real-time constraints of tasks (i.e. processes or threads) and synchronization of tasks that share resources or coordinate their activities.
RTS vs Embedded Systems (difference + some Applications, Properties/constraints of embedded real-time systems)
RTOS (RTOS vs GPOS, RTOS Market)

:. **POSIX**

POSIX thread model :

- Thread (Definition of a thread, Process vs thread, Advantages of Threads)
- Pthread API (creating, waiting, terminating pthread, fork() vs pthread_create)
- Resource sharing and synchronization tools (Critical Sections, Mutex, Producer-consumer synchronization, semaphores, Locking, Deadlocks, Barriers and condition variables, Reader-writer locks, problems).
- Clocks and timers management
- Scheduling of threads (FIFO, RR, ...)

.AB Sessions:

Make programs with real-time threads on Linux environment.
Work all notions seen in the lectures: do multi-threads programs, see the problem of using shared esources and solve it (Critical Sections, mutex, semaphore, condition variables,..)
Change the priority of thread and see how thread are scheduled under FIFO or RR algorithms.