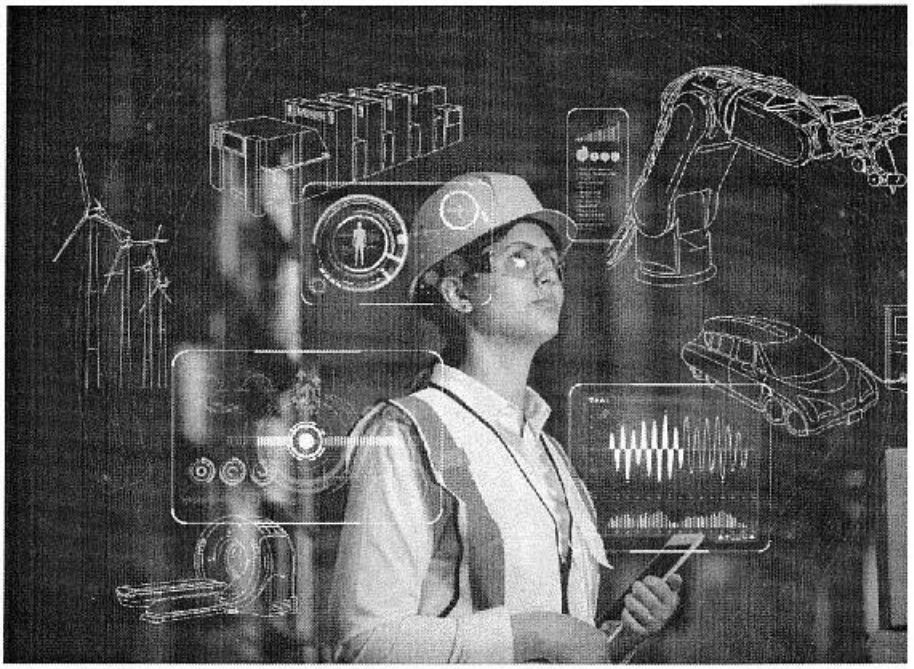
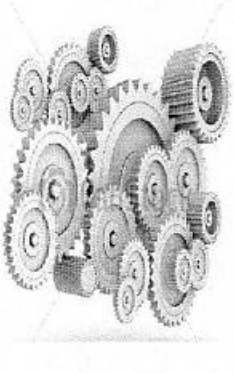
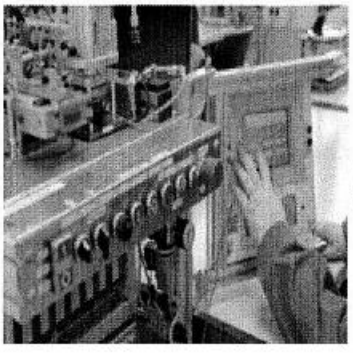
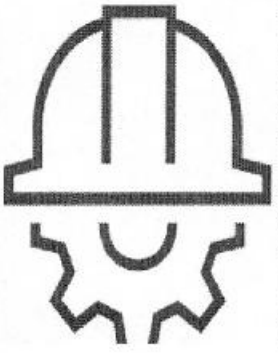
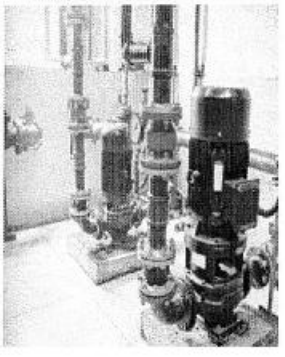
الجامعه الل
كليه التكنول

Maintenance and Industrial Engineering



Curriculum
Bachelor of Engineering
Maintenance and Industrial Engineering

Curriculum
Bachelor of Engineering
Maintenance and Industrial Engineering

Summary

Page

General Presentation and Objectives

The mission of the Maintenance and Industrial Engineering program is to prepare graduates to contribute towards modernization and optimization of the production operation. This program is created to meet the demand of industry by providing graduates with polyvalent skills and expertise required to become change makers in their field.

The program ensures a good balance between:

- Basic educational knowledge (computer science, expression, mathematics ...)
- Scientific and technological knowledge (electro technical, automatic, energy, mechanics)
- Specifities related to industrial realities: organization, production, methods, maintenance, safety and environment.

Furthermore, the graduates of the Maintenance and Industrial Engineering program are well prepared to pursue graduate studies (Masters and Engineer in Lebanon and abroad).

LEBANESE UNIVERSITY
Faculty of Technology

Program Course
Bachelor in
Maintenance and Industrial Engineering

الجامعة اللبنانية
كلية التكنولوجيا

L1

Semester 1

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS1ALGE	Algebra I (CE-IEM-CCNE)	3	15	15		30
LS1ANAL	Calculus I (CE-IEM-CCNE)	4	18	27		45
LS1CILO	Logic Circuits	4	15	18	12	45
LS1DETI	Drafting	2			30	30
LS1ELMA	Electricity and Magnetism	4	15	21	9	45
LS1FRAN	English (CE-IEM-CCNE-BC)	2		30		30
LS1MECA	Mechanics I	4	15	21	9	45
LS1THER	Thermodynamics	3	9	15	6	30
LS1TFME	Technology of Mechanical Manufacturing	3	9	15	21	45
Total	9	29	96	162	87	345

Semester 2

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS2ALGE	Algebra II (CE-IEM-CCNE)	3	15	15		30
LS2AGPG	Algorithmic and Programming	5	18	21	21	60
LS2ANAL	Calculus II (CE-IEM-CCNE)	4	18	27		45
LS2DRHO	Human Rights (CE-IEM-CCNE-BC)	2	30			30
LS2ELAN	Analog Electronics I (IEM-CCNE)	4	15	18	12	45
LS2MEFL	Fluid Mechanics	3	9	12	9	30
LS2MECA	Mechanics II	3	12	18		30
LS2PUEL	Electric Power	4	15	18	12	45
LS2TRTH	Heat Transfer	3	9	12	9	30
Total	9	31	141	141	63	345

L2

Semester 3

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS3ANAL	Calculus III (IEM-CCNE)	3	12	18		30
LS3ANGL	Foreign Languages (French) (CE-IEM-CCNE-BC)	2		30		30
LS3DAOR	Computer Aided Drafting	2			30	30
LS3ELPU	Power Electronics	4	15	15	15	45
LS3MAEL	Machines and Electrical Actuators I	5	21	24	15	60
LS3RDMA	Strength of Materials	4	12	18	15	45
LS3STPR	Statistics and Probability (CE-IEM)	4	18	27		45
LS3TCDM	Technology and Material Testing	3	9	15	6	30
LS3THPN	Pneumatic and Hydraulic Technology	3	9	12	9	30
Total	9	30	96	159	90	345

Semester 4

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS4CIPR	Programmable Circuits (IEM-CCNE)	4	12	15	18	45
LS4COAO	Computer Aided Design	2			30	30
LS4EXCO	Communication Skills (CE-IEM-CCNE-BC)	2		15	15	30
LS4MOCN	Numerically Controlled Machine Tool	4	12	15	18	45
LS4MAEL	Machines and Electrical Actuators II	4	12	18	15	45
LS4MATH	Thermal Machines	3	9	15	6	30
LS4MENU	Numerical Methods	3	12	15	18	45
LS4TEMM	Technology and Mechanical Maintenance I	4	12	15	18	45
LS4AULI	Linear Control (IEM-CCNE)*	4	12	15	18	45
LS4SYEX	Operating Systems (IEM-CCNE)*	4	15	15	15	45
Total	9	30	96	138	171	360

L3

Semester 5

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS5ENPR	Professional Environment	4	12	15	18	45
LS5ININ	Industrial Automation I	3	9	9	12	30
LS5ORGM	Maintenance Organization	4	15	18	12	45
LS5PDEE	Electric Power Production and Distribution	3	9	9	12	30
LS5TMM	Technology and Electrical Maintenance	4	12	18	15	45
LS5TEMM	Technology and Mechanical Maintenance II	4	12	15	18	45
LS5TEMT	Technology and Thermal Maintenance	3	9	12	9	30
LS5GEPR	Production Management*	4	12	18	15	45
LS5PRVH	VHDL Programming (IEM-CCNE)*	4	15	15	15	45
Total	9	29	105	129	126	315

Semester 6

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS6STAG	Internship	6				
LS6PFDE	Senior Project (= 180h/student-project)	12			180	180
LS6DRGT	General and Labor Law (CE-IEM-CCNE-BC)	1	15			15
LS6CSEF	Structural Calculations by Finite Element (CE-IEM)*	3	9	12	9	30
LS6LOGI	Logistics*	3	9	12	9	30
LS6MDMC	Continuum Mechanics*	3	9	12	9	30
LS6SYTH	Thermal System*	3	9	12	9	30
LS6ENRE	Renewable Energy*	3	9	12	9	30
LS6GEQU	Quality Management (CE-IEM)*	3	9	12	9	30
LS6ININ	Industrial Automation II*	3	9	12	9	30
LS6TRIN	Information Processing*	3	9	12	9	30
Total	7	31	51	48	216	315

* : Elective Courses ECTS : European Credit Transfert and accumulation System

Total ECTS :	180
Total Hours :	2025

Semester 1

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS1ALGE	Algebra I (CE-IEM-CCNE)	3	15	15		30
LS1ANAL	Calculus I (CE-IEM-CCNE)	4	18	27		45
LS1CILO	Logic Circuits	4	15	18	12	45
LS1DETI	Drafting	2			30	30
LS1ELMA	Electricity and Magnetism	4	15	21	9	45
LS1FRAN	English (CE-IEM-CCNE-BC)	2		30		30
LS1MECA	Mechanics 1	4	15	21	9	45
LS1THER	Thermodynamics	3	9	15	6	30
LS1TFME	Technology of Mechanical Manufacturing	3	9	15	21	45
Total	9	29	96	162	87	345

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

Departments: MIE-CCNE-CE

Objectives:

Give the students the mathematical tools necessary for the follow up of basic courses or specializing courses, in the frame of formation such as: complex numbers, calculation on polynomials and on rational fractions, use of the concepts of linear algebra (Matrices).

Contents:

Complex numbers:
Introduction
Definition of complex numbers and composition laws
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
Euclidean division and degree of multiplicity
Factorization of a real polynomial
Rational fractions
Irreducible and regular rational fractions
Partial fraction decomposition
Real Vector spaces:
Real vector spaces and examples
Real Subspaces
Linearly independent vectors, generating system
Bases and dimension of a vector space of finite dimension
Matrix 1:
Definitions and particular matrix
Square sub-matrix of a matrix

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS1ANAL	Calculus I	1	4	18	27	0

Departments: MIE-CE-CCNE

Objectives:

Give the students the basic mathematical tools necessary for the follow up of the courses, in the frame of formation, such as the study of functions, the finite expansion of functions, and the calculation of integrals

Contents:

Real functions of a real variable: Definitions, Operations on functions, Properties of functions, Limits of functions, Infinite branches- Asymptotes.
Continuity and Derivability of real functions: Continuity, Monotonic Functions, Inverse, Differentiability, Differentials.
Study of the usual real functions: Study of a function- steps, trigonometric functions, inverse trigonometric functions, Logarithmic function, Exponential function, Power function; Hyperbolic function, Inverse hyperbolic function.
Finite expansion: Definitions, Finite expansion of the usual real functions, Properties of the finite expansion, applications of the finite expansion.
Computation of integrals: Primitives, Definite integrals, integration techniques, Applications, Improper integrals.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS1CILO	Logic circuits	1	4	15	18	12

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The main objective of the course is the acquisition of fundamental knowledge in order to:

- Understand the fundamental principles leading to the design of commonly used digital systems.
- Be able to analyze, design and simulate logic circuits of medium complexity.
- Realize the importance of logic circuits concepts in the field of information technology and, where appropriate, be able to apply them in other areas.

Contents:

Introduction to logic circuits: analog signals vs digital signals, weighted numeration systems, binary, octal, decimal and hexadecimal systems, conversion between systems of different bases, binary arithmetic.
Boolean algebra: Basic laws, Morgan's theorem, Shannon's theorem, logical operations, representation and simplification of logical functions, Karnaugh map.
Combinational circuits: Multiplexers, Demultiplexers, adder, comparator, Encoder, Decoder, Transcoder.
Logic families: TTL and CMOS.
Sequential circuits: Sequential logic, RS, JK, D and T flip-flops.
Applications of sequential circuits: Memory registers, shift registers, synchronous and asynchronous counters.
Analysis and synthesis of synchronous sequential circuits: Mealy and Moore models.

LAB Sessions:

- Combinational logic and fundamental functions.
- Synthesis of a combinational system.
- Encoders / Decoders.
- Multiplexers / Demultiplexers.
- Adder / Comparator.
- The Flip - Flops: (RS, JK, D and T).
- Asynchronous counters and synchronous counters.
- Shift Registers.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS1DETI	Drafting	1	2			30

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The course introduces the students to technical drawing to know and use terminologies and standard of technical drawing. The course teaches the writing and reading of any drawing to meet the needs of maintenance technicians as well as interpreting and exploring the technical manual technical industrial sets.

LAB Sessions:

- Initiation /of /drawing on the board: how to use the drawing material & geometric construction.
- Types /of / graphical drawing and presentations: standard – representation rules of mechanical organs.
- Methodology drawn from a technical drawing.
- Conventions presentation – projection systems: View layout.
- Definition drawing – quotation.
- Cuts and sections.
- Perspective drawings.
- Threads – screw – bots: personal researches activities – consultation and usage of various data banks.
- Completely isolate and define a piece from an assembly drawing.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS1ELMA	Electricity and Magnetism	1	4	15	21	9

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

This course presents the basic concepts and principals (laws and theories) of electricity, which constitute the tools to solve practical problems of electrical circuits under different regimes of electric, and electromagnetism.

Contents:

Electrostatics: electric charge, Coulomb's law, electric fields E, D, electric flux, electric potential, Gauss's law, electrostatic energy, capacitance and dielectrics, applications.
Electromagnetic (Magnetostatics): magnetic fields B, H, magnetic materials, magnetic flux density, magnetic field created by a moving charge, the biot-savart law, ampere's law, inductance and magnetic energy, Laplace force, Lorentz force, applications.
Electric circuits:
Circuit Analysis basics: Voltage and electric Current, Ohm's law, The Ideal Basic Circuit Element, Power and Energy, Electrical resistance, Analysis of a circuit containing dependent sources.
Techniques of Circuit Analysis: Kirchhoff's Laws, the Voltage-Divider and Current-Divider Circuits, Delta-to-Wye (Pi-to-Tee) Equivalent Circuits, The Node-Voltage Method, The Mesh-Current Method, Source Transformations, Thevenin and Norton Equivalents circuits, Maximum Power Transfer, Superposition., Millman, Kennelly.
Response of First-Order RL and RC Circuits: The Step Response of RL and RC Circuits, A General Solution for Step and Natural Responses.
Natural and Step Responses of RLC Circuits: The Forms of the Natural Response of a Parallel RLC Circuit, the Step Response of a Parallel RLC Circuit, the Natural and Step Response of a Series RLC Circuit.
Sinusoidal Steady-State Analysis: The Sinusoidal Source, properties, average and effective value, harmonics, Fresnel, complex number, the Sinusoidal Response, the Phasor, The Passive Circuit Elements in the Frequency Domain, Kirchhoff s Laws in the Frequency Domain, Series, Parallel, and Delta-to-Wye Simplifications, Source Transformations and Thevenin-Norton Equivalent Circuits, The Node-Voltage Method, The Mesh-Current Method, Instantaneous Power, Average, Active and Reactive Power, The rms Value and Power Calculations, Complex Power, Power Calculations, Maximum Power Transfer.

LAB Sessions:

- Instrumentation, Measuring Voltage and Current, Measuring Resistance
- Voltage divider and current divider,
- Thévenin's theorem and superposition theorem.
- The Node-Voltage Method, The Mesh-Current Method
- Measure of impedance.
- The step response of RL and RC Circuits. The forms of the natural response of a parallel RLC Circuit, the natural and step response of a series RLC Circuit.
- Oscilloscope: function, measure…

Code	Title	Semester	ECTS	Lecture	Exercises	LAB
LS1FRAN	English	1	2	0	30	0

Departments: MIE-CCNE-CE-BC

Objectives:

The course purpose is to allow the students to reach a level of 400-500 for Toffel Exam.
The course is taught in a way to strengthen the listening and speaking skills to help the students communicate &express themselves easily. It also provides the students with the needed tools to improve their English skills in reading and writing.

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

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS1MECA	Mechanics I	1	4	15	21	9

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The study of mechanics allows students to acquire the necessary knowledge of kinematics, dynamics of point and vibration.

Contents:

Mathematical tools for mechanics
Kinematics of a point: generalities composition of the movements
Kinetics of a point: particular movements
The forces: physical laws – set of forces, torsors
Dynamics of a point
Energy study for the movement of a material point
Study of vibrations

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS1THER	Thermodynamics	1	3	9	15	6

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

- Know the parameters (pressure, volume, temperature) and state equations of perfect gas and real gas and the properties of the mixture of gases.
- Learn the statements of the two principles of thermodynamics.
- Study the transformations of gases and calculations of energies (work, heat, internal energy, entropy and enthalpy).
- Applications on the motors and the frigorific machines.

Contents:

Perfect gas: properties, state equation, mixing of perfect gases, massive heat (at constant volume and pressure)
Introduction to the Notions of: work, heat, internal energy, entropy and enthalpy
Introduction to the First principle of thermodynamics
Thermodynamics Transformations: isothermal, adiabatic, isobaric, and isochoric
Thermodynamic Diagrams: Clapeyron, entropy, enthalpy
Introduction to the Second principle of thermodynamics: Carnot cycle, Beau de Rochas Cycle, diesel cycle
Applications: Motors and refrigerators, efficiency
Real gases: isotherm of real gases, state equation and thermo-elastic coefficients

LAB Session:

- Particular transformations of perfect gases (isothermal, isochoric, and isobaric) and verification of state equations.
- Determination of the mass in water of the calorimeter and the massive heat of the metals (copper, aluminum, lead…).
- Phenomena of phase change: vaporization, liquefaction (condensation).
- Principle of equivalence and phenomena of energy degradation; transformation of work into heat.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS1TFME	Technology of Mechanical Manufacturing	1	3	9	15	21

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The main objective of the course is to teach students the subjects related to the manufacturing of mechanical part. First, they will gain knowledge of the elements used in the design of mechanical parts. Further, the major machine processes used in manufacturing will be studied where students will integrate a series of know-how related to the manufacturing processes. Thus, students will be able to assess the difficulties of machine processes entailed by poorly defined functional dimensioning.

Contents:

Introduction of manufacturing of mechanical part
Dimensional tolerances and fits
Functional dimensioning
Metrology
Introducing of the different production processes: without material removal (molding, welding, stamping...); with material removal (turning, milling, drilling…).

LAB Sessions:

- 3 conventional lathes
- 2 conventional milling machines
- 4 columns Drills
- 3 positions of electric arc welding
- 3 oxygen acetylene welding stations
- 2 grinding machines

Semester 2

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS2ALGE	Algebra II (CE-IEM-CCNE)	3	15	15		30
LS2AGPG	Algorithmic and Programming	5	18	21	21	60
LS2ANAL	Calculus II (CE-IEM-CCNE)	4	18	27		45
LS2DRHO	Human Rights (CE-IEM-CCNE-BC)	2	30			30
LS2ELAN	Analog Electronics I (IEM-CCNE)	4	15	18	12	45
LS2MEFL	Fluid Mechanics	3	9	12	9	30
LS2MECA	Mechanics II	3	12	18		30
LS2PUEL	Electric Power	4	15	18	12	45
LS2TRTH	Heat Transfer	3	9	12	9	30
Total	9	31	141	141	63	345

Code	Title	Semester	ECTS	Courses	Exercises	Lab
LS2ALGE	Algebra II	2	3	15	15	0

Departments: MIE-CCNE-CE

Objectives:
The course is useful to give 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 matrices and properties
Scalar multiplication and properties
Transpose of a matrix and properties
Product of two matrices and properties
Elementary row operations
Determinants:
Definition of the determinant and properties
The inverse of a matrix and properties
Linear transformations and matrices:
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	ECTS	Courses	Exercises	LAB
LS2AGPG	Algorithm and Programming	2	5	18	21	21

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

- Acquire the basic concepts of algorithms. Acquire the basics of structured programming.
- Understand the algorithmic concepts of structured programming, modular and functional. Introduce and handle different data structures.

Contents:

Introduction to the application concept of computer program. Notions of syntax, and compilation semantics. Algorithmic concepts of structured programming: basic elements, declarations, types, variables, operators, expressions, statements, conditional and control structures, syntax diagram, table in one and two dimensions, different sorting methods, structures; procedures and functions, recursion.
Deepen the notions of application and computer program.
Performance analysis and optimization.
Pointers, structures, recursion. Structure pointers.
Abstract data types: Pile, File, List (single, circular and double) and binary trees.
Modularity: modules, files and visibility variables (basic concept).
The processing of text and binary files (creation, modification and display)
N.B.: Algorithmic concepts are applied on the C language.

LAB Sessions:

- Logical elements. Type and variable declarations. Procedures and functions. Passage by value and by reference. The tables. The structures. Recursion.
- Tables (sorting, recursion), pointers and structures, piles and queues, lists, trees, files.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS2ANAL	Calculus II	2	4	18	27	0

Departments: MIE-CE-CCNE

Objectives:

Give the students the basic mathematical tools necessary for the follow up of the courses, in the frame of formation, such as simple operational calculation, calculation of multiple integrals, language of series, and use of mathematical tools for the application in 3EA.

Contents:

Differential equations: Differential equations of first order, differential equations of second order, differential equations of any order with constant coefficients.
Functions of several variables: Definitions, Functions of two and three variables, Limits and continuity, Partial derivatives, Total Differential, Different types of coordinates.
Operators of Vector Analysis: Review of analytic geometry, Scalar field-Vector field, Gradient, Laplacian, Divergence, curl.
Multiple integrals: Definitions, Calculating double and triple integrals, Application: Mass of a plate, Center of mass, Moments of inertia, flux.
Numerical sequences: Definitions, Arithmetic and geometric sequences, global behavior and at infinity, Limits, Equivalent sequences, Adjacent sequences.
Numerical series: Definitions, Convergence, Divergence, geometric series, series with positive terms, RMIEann series, Alembert and Cauchy tests, series with terms of different sign, Alternated series, Power series and expansion into power series.
Fourier series: Trigonometric series, Evaluation of coefficients, Expansion into Fourier series: case of 2π-periodic functions and T-periodic functions, Complex form of Fourier series, Applications.

Code	Title	Semester	ECTS	Courses	Exercises
LS2DRHO	Human rights حقوق الإنسان	2	2	30	0

epartments: CE-MIE-CCNE-BC

bjectives:

wareness of human rights and strengthening the links between humans.

ontents:

rst part: concept and context of human right

1. Human right concept
2. Intellectual context of human right
3. Historical review
4. Resources and references

econd part: human right content

1. Personal rights
2. Legal and juridical rights
3. Political rights
4. Right of free thought (belief, expression, education, cultural participation)
5. Social and economic rights.

سم الأوّل :ماهية حقوق ألإنسان

1. **مفهوم حقوق الانسان** (حصة واحدة) : تعريف حقوق الانسان، التمييز بين الحق والحريّة، دولة القانون، الديمقراطيّ
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، حقو الإنسان عند العرب.
4. **مصادر حقوق الإنسان** (3 حصص): المواثيق العالميّة، مواثيق دوليّة خاصّة، المواثيق الإقليميّة، المصادر الداخليّة.

سم 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.

قوق الإجتماعيّة والإقتصاديّة (حصتان): الحق في الزواج وتكوين الأسرة، الملكيّة الخاصّة، مساواة المرأة مع الرجل، الضم جتماعي، العمل، الأمومة، حقوق الطفل.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS2ELAN	Analog Electronics I	2	4	15	18	12

Department: MIE-CCNE

Objectives:

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 diodes. Applications of diodes: Rectifier, stabilization..
Characteristics of bipolar transistors. Basic circuits: Common Emitter (CE), Common Collector (CC) and Common Base (CB). Characteristics of JFET. Basic circuits: Common Gate (CG), Common Source (CS) and Common Drain (CD). Operational amplifier: Applications (inverting, non-inverting, integrator, derivate, etc..).

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS2MEFL	Fluid Mechanics	2	3	9	12	9

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

Introduce the basic principles of fluid mechanics required for the understanding and analysis of hydraulics systems components such as pumps, valves, distributor, actuator...

Contents:

Generalities: the continuum assumption, properties of fluids, viscosity, viscous and inviscid flow, body and surface forces, external and internal forces
Fluid Statics: pressure at a point, absolute and gage pressure, units, variation of pressure with depth, pressure measurement (piezometer, barometer, and manometer), calculation of hydrostatic force on planar and curved surfaces, centre of pressure, buoyancy and stability.
Fluid kinematics: Lagrangian and Eulerian descriptions, definitions of streamlines and pathlines, Reynold Transport Theorem (RTT), volume and mass flow rates, continuity equation (conservation of mass), applications.
Fluid dynamics: linear momentum equation, Bernoulli equation, static and dynamic pressures, Energy Grade Line and Hydraulic Grade Line, head loss, energy equation, power of pumps and turbines, efficiency, applications : draining time, pitot tube, venturi tube, check valve, etc...
Laminar and turbulent flow: Reynold number, friction factor, major and minor losses

LAB Sessions:

- Impact of a jet on planar, conical and hemispherical surfaces
- Energy losses for laminar and turbulent flow
- Draining time of cylindrical, conical and spherical reservoirs
- Velocity and flow rate measurements using venturi tube
- Head loss in horizontal pipes, elbow, enlargement and contraction
- Flow rate measurement using orifice plate

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS2MECA	Mechanics II	2	3	12	18	0

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisite: Mechanics 1.

Objectives:

The study of mechanics allows students to acquire the necessary knowledge in kinematics, statics and dynamics of solid of a material system and to perform simple element calculations of linkages.

Contents:

Kinematics of a solid: particular movements
Mechanical connections - Modeling
Statics of a solid
The fundamental principle of dynamics for materiel systems
Energetic study.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS2PUEL	Electric Power	2	4	15	18	12

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

This course is an introduction of the power system analysis. It explains how to calculate the electrical power in industrial applications, how to improve the power factor of an electrical industrial installation and introduce the student about the concept of electrical calculation in the case of an electrical fault or in the case of an unbalance network.

Contents:

Reminder: ohms law, Kirchhoff's law, superposition, millman, thevenin and Norton equivalents circuits, Kennelly.
AC circuits: instantaneous voltage and current, effective value, average value, Fresnel.
Power in single-phase AC circuits: Fresnel representations, complex numbers, active power, reactive power, apparent power, power factor, power factor correction, of Boucherot's Theorem.
Non-sinusoidal Single phase: Harmonics, RMS, And Power: active, reactive, deformed, and apparent
Balanced three-phase system: Y and delta–connected load, Power in three-phase system.
Unbalanced three-phase power circuits: Direct system, inverse, zero sequence, Theorem of Fortescue, calculation of electrical faults by the symmetrical components

LAB Sessions:

- Single-phase system: power measurement and power factor correction (adding capacitors, synchronous compensator).
- Balanced and unbalanced three-phase system: Measurement of three phase power, methods two wattmeter and three wattmeter, Application of Boucherot's theorem, Measure of electrical quantities in a fault, Simulation and calculation of a fault.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS2TRTH	Heat transfer	2	3	9	12	9

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

This course is useful to acquire basic knowledge in the field of heat transfer, mastering the concepts and fundamental laws of conduction, convection and radiation, apply them in solving practical problems in heat transfer domain and use them to design thermal industrial systems.

Contents:

In order to achieve the academic objectives, the course is composed of 8 chapters and organized as follows:
Introduction to heat transfer: Modes, regimes.
Heat transfer by conduction: Fourier's law, Heat diffusion equation, heat transfer in a plane wall, thermal resistance.
Heat conduction in cylindrical and spherical systems.
Heat Transfer by Convection: modes, Newton's law of cooling. Forced convection: Reynolds number, regimes of heat transfer: "laminar" and "turbulent, Nusselt number, Prandtl number, internal and external heat transfer, convection heat transfer coefficient. Natural convection: Grashof Number, Nusselt number and Rayleigh number.
Radiation heat transfer: Black body radiation, Planck's law, Wien's displacement law Stephan-Boltzman law, emissivity, absorptivity, reflectivity, transmissivity, Kirchhoff's Law, view factor Radiation exchange between black bodies and real surfaces.

LAB Sessions:

- -Heat conduction in solids: calculate the thermal conductivity k of an insulation material (e.g. Expanded polystyrene)
- Heat transfer by convection: forced and natural convection
- -Heat transfer by radiation: Verify different laws of radiation heat transfer, Emissivity of different surfaces.
- Heat exchanger: Find the convection heat transfer coefficient in the condenser and evaporator of a water/water heat pump, calculate the total heat flux.
- Solar collector: study of the solar collector system used in water heating, find the volume flowrate of water, and apply the energy balance.

Semester 3

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS3ANAL	Calculus III (IEM-CCNE)	3	12	18		30
LS3ANGL	Foreign Languages (French) (CE-IEM-CCNE-BC)	2		30		30
LS3DAOR	Computer Aided Drafting	2			30	30
LS3ELPU	Power Electronics	4	15	15	15	45
LS3MAEL	Machines and Electrical Actuators I	5	21	24	15	60
LS3RDMA	Strength of Materials	4	12	18	15	45
LS3STPR	Statistics and Probability (CE-IEM)	4	18	27		45
LS3TCDM	Technology and Material Testing	3	9	15	6	30
LS3THPN	Pneumatic and Hydraulic Technology	3	9	12	9	30
Total	9	30	96	159	90	345

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS3ANAL	Calculus III	3	3	12	18	0

Departments: MIE-CCNE

Objectives:

This course is useful in giving the students the basic mathematical tools necessary for the follow up of the courses, in the frame of formation, such as use of mathematical tools for the application in 3EA.

Contents:

Fourier series: Trigonometric series, Evaluation of coefficients, Expansion into Fourier series: case of 2π-periodic functions and T-periodic functions, Complex form of Fourier series, Applications.
Fourier Transform: Definitions, Fourier transform of usual functions, properties, Applications.
Laplace transform: Definitions, Laplace transform of usual functions, Properties, Inverse laplace transform, Applications.

Code	Title	Semester	ECTS	Courses	Exercises	LA
LS3ANGL	Foreign Languages (French)	3	2	0	30	0

epartments: MIE-CCNE-CE-BC

bjectifs :

e cours de langue française est un cours conçu pour des étudiants ayant une formation génér
ı technique. Ce cours développe les capacités de lecture, d'écriture et de conversation aussi bi
ıe l'amélioration de la prononciation et l'augmentation du vocabulaire. Une attention particuli
t portée à la lecture et à la compréhension. L'objectif principal de ce cours est d'enseigner
ompétence communicative, qui est la capacité de communiquer en français en fonction de
ıuation, de l'objet et du statut des participants.

ontenu :

ı première partie du cours est axée sur le vocabulaire essentiel, la lecture, la conversation
écriture : Portrait des étudiants, liste des détails des compétences personnelles, statut actu
ırcours et responsabilités.
ı seconde partie est axée sur le vocabulaire technique, la discussion autour de sujets techniqu
ınalyse de rapports techniques (articles, papiers de recherche, projets) et quelques activités
ommunication.

bjectives:

ench is a course designated for students with basic and technical major. This course covers t
ills of reading, writing, and speaking as well as improving pronunciation and building vocabula
ırticular emphasis is placed on reading and comprehension. The primary goal of this course is
ach communicative competence, that is, the ability to communicate in French according to t
tuation, purpose and roles of the participants.

ontents:

this course, the first part focused on: key vocabulary, reading, grammar, speaking and writir
ıdent Portrait, list all details of personal skills, present position, background and prese
sponsibilities.
ıe second part focused on: technical words, discussion about technical topics, analysis of techni
ports (projects, articles, papers,…) and communication activities.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS3DAOR	Computer Aided Drafting	3	2	0	0	30

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

This course helps the students in drawing mechanical parts: screws, bolts, studs, nuts, gears; Assembling of mechanical parts; Introducing the three-dimensional computer-aided design, which enable the student to realize, visualize and print a complex volume, develop a strategy to achieve a complex volume.

LAB Sessions:

- Two-dimensional computer-aided design
- Making drawings with Autocad
- Modify a drawing
- Handling text and styles in Autocad
- Annotating and Composing Plans
- Importing and exporting Autocad files
- Three-dimensional computer-aided design

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS3ELPU	Power Electronics	3	4	15	15	15

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The course helps the students to understand the fundamentals and the devices of power electronics. The theory of switches is also acquired to then approach the families of conversion: AC-DC, DC-DC, AC-AC, DC-AC. Finally, it presents the study of the converters frequently used in industry.

Contents:

Power electronics components.
AC-DC converters: Study of rectifiers with diodes or thyristors.
Examples: Non-controlled rectifiers, Controlled rectifiers.
DC-DC converters: Serial chopper (Buck chopper), parallel chopper (Boost Chopper), equations and waveforms.
AC-AC converters: single-phase AC-to-AC voltage regulator, equations, three-phase AC-to-AC voltage regulator.
DC-AC converters (inverters): Single-phase voltage inverters, principles, equations and waveforms, types of controls (PWM ....), choice of components.

LAB Sessions:

Rectifiers PD2, PD3, PT3, etc ; The choppers; Single-phase and three-phase AC-to-AC voltage regulator; Single phase inverter; Simulation (CAD): Rectifiers PD2, PT2, PD3, PT3, mixed; Chopper; single-phase and three-phase AC-to-AC voltage regulator; single-phase voltage inverter; power electronics devices in combination with electrical machines.

Code	Title	Semester	ECTS	Courses	Exercises	LA
LS3MAEL	Machines and Electrical Actuators I	3	5	21	24	15

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

Study the magnetic circuits and their excitations by alternating electric current. Study the particular applications: Transformers and DC electrical machines. Know how to model these machines and devices, and know how to calculate and choose its characteristics according to the industrial application. To acquire the necessary knowledge to the understanding of the functioning of the electric actuators and their electronic controls.

Contents:

Reminders: Laplace force, Lorentz electromotive force, Lenz's law, Biot and Savart's law, Ampère's theorem.
Magnetic circuits: Magnetic energy, magnetic flux, reluctance concept, Hopkinson law, association of reluctances, coefficient of self and mutual inductance, Blondel dispersion coefficient and coupling coefficient.
Alternative magnetic excitation: Hysteresis, Eddy current, core losses.
Single-phase transformer, single-phase autotransformer, potential transformer, current transformer
Three-phase transformer.
Initiation to rotating machines, the conversion of electrical energy into mechanical energy.
Rotating DC machines: Structure of a DC machine. Separately excited DC machine, shunt excited DC machine, series excited DC machine. Universal motor.
Special motors: Stepper motor, permanent magnet motor, servomotors.
Transient regime of a DC machine.
Speed variation of a DC machine: Introduction, equivalent model, structures and selection criteria of the drives.

LAB Sessions:

Single-phase transformers: Measurement of core and joules losses, determination of the parameter of the equivalent diagram, load test and voltage drops calculation for different loads.
Three-phase transformers: Determination of the phase shift etc...
Series of LAB sessions on separately excited DC machines and series DC machines.
Speed variation of DC motor by: An autotransformer, chopper, controlled rectifier.
Speed variation of a stepper motor.
Lists of practical work on servomotors.
Simulation (CAD).

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS3RDMA	Strength of Materials	3	4	12	18	15

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisite: Mechanics II.

Objectives:

The course is useful in acquiring the basic notions of mechanics of materials, necessary to understand the mechanical behavior of simple structures, calculating the stresses and strain of the beams in the case of simple stresses and finally dimensioning a shaft or mechanical parts.

Contents:

Review of: forces, moments, systems of forces, hypothesis of the local equilibrium
Hypothesis on the mechanics of materials (Introduction, history, hypothesis on the material, homogeneity, isotropy, elasticity, hypothesis of the local equilibrium, boundary conditions, tension, compression…)
Concept of the internal forces, stresses (Introduction, internal forces, identifying the components, Diagrams, strains - Vector strain, allowable stresses)
Studies of simple stresses cases (tension, compression, shear stress, torsion of circular profiles)
Stress concentration (Introduction, stress concentration factors, approximate formulas and software's)
Buckling (Introduction, Euler formula, Dimensioning)

LAB Sessions:

Test and measurement of stress and strains on beams under simple stresses (tension, torsion, deflections)

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS3STPR	Statistics and Probability	3	4	18	27	0

Departments: MIE-CE

Objectives:

The course allows the students to use of elements of the statistical processing of data, calculate the simple and conditional probabilities and use of random variables and associated laws. Furthermore, the course introduces the basic tools of inferential statistics and their use.

Contents:

Descriptive Statistics: Statistics Vocabulary, Discrete and Continuous Statistical Variables, Characteristic Values (Mean, Variance and Standard Deviation). Two-Variable Statistical Series, Linear Regression and Correlation.

Probabilistic statistics:

1) **Combinatorial Analysis and Probabilities:** Counts, Probability Language, Probability on a Finite Universe, Conditional Probabilities, Bayes Formula, Independence in Probability.

2) **Random variables:** Discrete random variables on a finite universe, Law of probability and distribution function, Characteristic values (Mathematical expectancy and Variance). Discrete random variables on an infinite universe. Continuous Random Variables, Probability Density, Characteristic Values. Usual laws: Uniform discrete, BERNOUILLI, Binomial, FISH, Geometric, Uniform continuous, Normal (LAPLACE - GAUSS), Exponential. Operations on random variables.

Inferential Statistics: Sampling: Problem and Law of Sampling, Non-exhaustive and exhaustive sample. Estimate: Introduction, Point estimation, Confidence interval estimation. Test Theories: Hypothesis Tests, Comparison of Averages and Frequencies (Bilateral and Unilateral Tests)

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS3TCDM	Technology and Materials Testing	3	3	9	15	6

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The course aims towards:

- Recognize the different types of materials according to their physical, mechanical and structural properties and know their structures.
- Know the behavior of materials and of metals in different cases.
- Know how to choose the materials and how to control them without destruction.

Contents:

Crystalline structure of materials: simple cubic, centered cubic, faced centered cubic, hexagonal.
Material classifications: Metals, ceramic, glasses, polymers and composites.
Characteristics of materials:
Physical (melting point, density, electric resistivity, thermal conductivity, magnetic properties)
Mechanical (Tension test, Hardness test, fatigue test, Impact test)
Structural (X-Ray diffraction, Electrical diffraction, energy dispersive spectrometers, Transmission electron microscopy).
Phase Diagrams: Thermal treatment, Binary Isomorphous Systems, atom and weight percent composition, the percentages or fractions of the phases, (Eutectic, Eutectoïdes and Peritec reactions), the kinetic of phase transformation.
Inperfections in solids: Schottky, Frenkel, Interstitial, Pair de Frenkel, specification of composition, dislocation – linear defects, Microscopic techniques.
Failure: Corrosion and protection – fundamentals of fracture.
Non-destructive testing: ultrasonic, acoustic emission and industrial radiological

LAB Sessions:

- Hardness mesure (Brinell and Rockwell B).
- Measurement of the lattice parameters (by optical diffraction, by direct measurement).
- Roughness measurement, Optical measurement for low thicknesses materials.
- Construction of diffraction patterns of a cubic structure with Miller indices.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS3THPN	Pneumatic and Hydraulic Technology	3	3	9	12	9

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Fluid mechanics.

Objectives:
The course presents the fundamentals of fluid power technology: hydraulic fluids, hydraulic pipes, pumps, hydraulic cylinders and cushioning devices, motors, and valves, hydraulic circuit design and analysis, hydraulic conductors and fittings, ancillary hydraulic devices. Furthermore, the course presents the pneumatics: air preparation, components, circuits and applications, basic and advanced electrical controls for fluid power circuits, and fluid logic control systems are also introduced and discussed

Contents:

Basic function of hydraulic and pneumatic systems;
Relationships of pressure, flow, power, force and torque;
Types of components of a power transmission system;
Hydraulic components:
Pumps: characteristics of various types of pumps (gear pumps, vane, piston);
The hydraulic motors;
The basic accessories (valves, flow stranglers, pressure control, etc ...);
The energy balance;
Line losses;
Losses and efficiency of pumps and cylinders;
Thermal equilibrium (Thermal balance);

LAB Sessions:

Hydraulic systems (Hydraulic circuits):
Safety circuits;
Circuits with several cylinders;
Circuits with several pressure levels;
Proposal constructive solutions (choice of components);
Pneumatic circuits Power:
Compressed air in the industry: industrial processes using compressed air;
Pneumatic components: compressors, actuators, valves and accessories;
Dimensional determination of components and power circuits.

Semester 4

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS4CIPR	Programmable Circuits (IEM-CCNE)	4	12	15	18	45
LS4COAO	Computer Aided Design	2			30	30
LS4EXCO	Communication Skills (CE-IEM-CCNE-BC)	2		15	15	30
LS4MOCN	Numerically Controlled Machine Tool	4	12	15	18	45
LS4MAEL	Machines and Electrical Actuators II	4	12	18	15	45
LS4MATH	Thermal Machines	3	9	15	6	30
LS4MENU	Numerical Methods	3	12	15	18	45
LS4TEMM	Technology and Mechanical Maintenance I	4	12	15	18	45
LS4AULI	Linear Control (IEM-CCNE)*	4	12	15	18	45
LS4SYEX	Operating Systems (IEM-CCNE)*	4	15	15	15	45
Total	9	30	96	138	171	360

Code	Title	Semester	ECTS	Lecture	Exercises	LAB
LS4CIPR	Programmable Circuits	4	4	12	15	18

Department: MIE-CCNE

Pre-requisites: Algorithmic and Programming, Logic Circuits.

Objectives:

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

Contents:

The memories: ROM and RAM memory, Block diagram of a memory, Timing diagrams in memory for read / write operation, Classification of memories.
Architecture and operation of a microprocessor: Structure of computing, Organization of the central memory, Description of a microprocessor, Microprocessor operation, stack, interrupts, inputs / 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, Interruption, 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 simulation of Arduino platform in PROTEUS.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS4COAO	Computer Aided Design	4	2	0	0	30

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

This course aims to introduce the SolidWorks Software. The SOLIDWORKS® CAD software is a mechanical design automation (2D-3D) application that lets designers quickly sketch out ideas, experiment with features and dimensions, and produce models and detailed drawings. In addition, the SOLIDWORKS® could be used for simulation as heat transfer, solid stresses, fluid mechanics etc

Contents:

-Introduction to Solid Works (Part Mode, Assembly Mode, Drawing Mode)
-Familiarize with the software Solidworks (Menu Bar and Solid Works menus, Command Manager Toolbar Dimensioning Standard and Units Drawing sketches Starting a New Document in Solid Works, Editing Sketched Entities,, creat geometries, modifying geometries, drilling, threading, chamfer, extrude, revolve etc…)
-Working with drawing views (Types of Views, Generating Standard Drawing Views, Editing and Modifying Drawing Views, Adding Annotations to Drawing Views, Dimensions)
-Assembly modeling (Moving and rotating Individual Components, Assembly Visualization, Advanced Assembly Mates, Mechanical Mates, Editing Assembly Mates etc…)
-Using library tools for assembling (gears, screw, rolling etc…)
-Make a motion study for complicated design (linear and rotational motions)
-Introduce some examples using the simulation feature (solid mechanics, heat transfer…)

Code	Title	Semester	ECTS	Lecture	Exercises	LAB
LS4EXCO	Communication Skills	4	2	0	15	15

Departments: MIE-CCNE-CE-BC

Objectives:

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.

Contents:

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	ECTS	Courses	Exercises	LA
LS4MOCN	Numerically Controlled Machine Tool	4	4	12	15	18

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The course will enable students to understand the whole process of CNC machining so that they are aware and have knowledge of the process, and it does not take them as surprise when they see these machines in the industry. Having prior knowledge and understanding will enable them to take part in decision making as well. This basic course is designed around the idea of knowledge, awareness and hands-on training.

Contents:

Introduction to numerical control machining and FAO.
Manual programming of MOCNs, preparatory functions G and auxiliary function M and preprogrammed cycles.
Geometric profile programming.
Structured programming.
Parameterized programming.
Interactive programming.
The order directors are NUM, Fanuc, Fagor.

LAB Sessions:

Exercises on machine & Practice

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS4MAEL	Machines and Electrical Actuators II	4	4	12	18	15

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Machines and Electrical Actuators I, some basic concepts in electrotechnics and electronics are desirable.

Objectives:

This course is the continuation of the Machines and Electrical Actuators I course.
The objectives are to deepen the study of the electrical machines, to know their elements, to know how to model electrical machines and to acquire the necessary knowledge to the understanding of the functioning of the electric actuators and their electronic control.

Contents:
Reminders of the fundamental laws.
Rotating magnetic field.
Synchronous AC machines: Structure, equation, stability, power balance, Blondel diagram, different excitation modes, alternator coupling on the network.
Asynchronous AC machines: Structure, equation, power balance, circle diagram.
Speed variation: Starting of asynchronous motors: Starting of a three-phase motor using: An autotransformer, wye to delta manual and automatic start. Starting of several three-phase motors according to imposed specifications.
Starting a three-phase motor including reactive power compensation using capacitor banks. Braking of a three phase asynchronous motor by injection of a direct current. Two speed asynchronous motor: Separate winding motor, pole switching windings motor (Dahlender).
Speed variation of asynchronous motors: General - action on the slip - coupling of the poles - scalar control - vector control.

LAB Sessions:

Series of LAB sessions on: Asynchronous and synchronous machines, network coupling and synchronous compensator.
Starting a three-phase asynchronous motor: Y-Δ, inverter, two speeds etc.
Speed variation of three-phase asynchronous motor by a Variable Frequency Drive (VFD).
Simulation (CAD).

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS4MATH	Thermal Machines	4	3	9	15	6

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Thermodynamics.

Objectives:

The course objective is to provide students with the different methods and tools used in the technology and maintenance of thermal machines; study of technology, architecture, analyze of the cycle and the diagrams, calculates sizing, assessment features, and maintenance methods.

Contents:

1. **Reciprocating compressors**:
- Study of cycle, diagram and cooling technology for various piston compressors;
- Calculation of efficiency, flow rates, and dimensions for various piston compressors.
2. **Centrifugal compressors:**
- Study of architectures for single-stage compressor and multistage compressor;
- Study of theoretical and real compression;
- Calculation of dimensioning for single-stage compressor and multistage compressor;
3. **Axial compressors:** Study of architecture and dimensioning for multistage compressor.
4. **Steam turbines:** Study of architecture, fundamental equations, cycles, and efficiency.
5. **Gas turbines**: Study of constitution, components, cycles and efficiency.
6. **Combustion engines and diesel engines**:
- Study of operation, cycles and efficiency;
- Calculation of dimensioning of combustion and diesel engines.
7. **Maintenance of thermal machines:**
- Routine maintenance (corrective maintenance), performance verification, preventive maintenance;
- Strategy of protection.

LAB Sessions:
Measurements on various types of compressor, thermal turbines and engines

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS4MENU	Numerical Methods	4	3	12	15	18

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The objective is to be familiar with the numerical methods for engineer's calculation, and their applications in the field of mathematical calculations.

Contents:

- **Solve the equation f(x) = 0**: Separating of roots: Experimental method, Roll's theorem, graphical method. Approximation of a root: Substitution method, Bisection method, Newton – Raphson method, Fixed-point method.
- **Resolution of linear system**: Introduction, the direct methods: Cramer's rule, Gauss method. The iterative methods: Algorithm of Jacobi, Gauss-Seidel method.
- **Numerical solution of differential equation**: Introduction, Euler's method, method using Taylor formula, Runge-Kutta's method.
- **Polynomial interpolation:** Introduction, Interpolation and extrapolation, linear interpolation, quadratic interpolation, Lagrange interpolation.
- **The method of Least Square**: Introduction, method of Least Square: straight line, general method, weighted Least Square.

LAB Sessions:

Programming of the different methods by a suitable programming language (C language or any other language) or the use of Matlab software or any equivalent software.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS4TEMM	Technology and Mechanical Maintenance I	4	4	12	15	18

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Technology of Mechanical Manufacturing (TMM)

Objectives:

Acquire a fundamental knowledge's and notions well-structured about modeling, repairing and configuring, which allows the understanding of different part's behavior of an industrial technical systems, design of different mechanical parts, the study of different mechanism's behavior and linkage synthesis. Finally, the study of mechanical parts integrated in a mechanical assembly.

Contents:

- Basic concept of mechanical action's modeling: case study of an industrial mechanism were we should define relative motions, degrees of freedom with the aim of linkage's analysis, find equivalent linkages, make the kinematic diagram and draw the linkage graph.
- Power transmission principal; the study of shaft's coupling.
- Modeling of the input/output parameters of a power transmission system, number of rotation, torque and type of motion.
- Different types of gears.
- Case study of the gear box,
  - Planetary Gear Trains
  - Parallel-Axis Gear Trains.
- Transmission via flexible links
  - Pulleys and belts, wheels and chains.

LAB Sessions:

The main objective of this booklet is to teach the student practical methods of assembly measurement and identification of functional blocks that constitute a chain of power transmissior and transformation of movement to satisfy the expectations of the industrialist.

- TP 1 Study of a rotation regularimeter.
- TP 2 Study of a differential system.
- TP 3 Study of a pendulum gearbox.
- TP 4 Study of an epicyclic gearbox.
- TP 5 Study of a power transmission chain.

(*)The applied technological character of this course implies the interference between Courses Tutorial and Practice.

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

Departments: MIE-CCNE

Pre-requisites: Machines and Electrical Actuators I, Calculus III.

Objectives:

- 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.

Contents:

Introduction to linear control system: (control and regulation).
Modeling of linear systems (1st and 2nd order). Modeling in State Space.
Open- loop and Closed-loop Control Systems. (Bode, Nyquist and Black diagrams).
Response and performances of feedback loop systems (stability, static and dynamic accuracy…).
PID control – ON/OFF control.

LAB 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	ECTS	Courses	Exercises	LAB
LS4SYEX	Operating Systems	4	4	15	15	15

Department: MIE-CCNE

Pre-requisites: Algorithm and Programming.

Objectives:

The course is useful in the introduction to operating systems, installation and using of Linux systen creation of Shell scripts, acquisition of programming techniques based on semaphores related to rea time applications 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).
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 managemen – Access modes; Process management - redirection; Process communication through tubes; Unix-based Office Text and Graphics; Creation of processes; Application semaphore; script programming language; Administration.

Semester 5

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS5ENPR	Professional Environment	4	12	15	18	45
LS5ININ	Industrial Automation I	3	9	9	12	30
LS5ORGM	Maintenance Organization	4	15	18	12	45
LS5PDEE	Electric Power Production and Distribution	3	9	9	12	30
LS5TMM	Technology and Electrical Maintenance	4	12	18	15	45
LS5TEMM	Technology and Mechanical Maintenance II	4	12	15	18	45
LS5TEMT	Technology and Thermal Maintenance	3	9	12	9	30
LS5GEPR	Production Management*	4	12	18	15	45
LS5PRVH	VHDL Programming (IEM-CCNE)*	4	15	15	15	45
Total	9	29	105	129	126	315

Code	Title	Semester	ECTS	Courses	Exercises	I
LS5ENPR	Professional Environment	5	4	12	15	

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The course gives an overview of the concept "ENVIRONMENT" by combining scientific, technical and technological knowledge. It helps in understanding the themes: "Ecology, Pollution and Treatment, Waste and Treatment, Renewable Energies, ISO 9000 and 14000 Standards, Environmental Management System" and their interactions with industry, "Sustainable Development" policy, learning the main technical factors, which constitute the strictly industrial element of the machining complex, considering them with two aspects (Technical and human). Finally, it focuses in studying the parameters that directly influence the physical, physiological or psychic behavior of personnel with the consequences that may result for the performance of the establishment.

Contents:

- Industrial Environment, Safety and Ergonomics Standards, Safety and Design.
- Technical aspects in industry: Production and distribution of fluids, handling and circulation, storage of materials.
- Human aspects in the industry: Ventilation and ventilation, light and color, workplace temperature, humidity, noise, noise control.
- Effects of work on man: Occupational diseases, prevention. Types of fatigue; causes and remedies.
- Struggle and protection against industry: Preventive measures, fire classification.
- Atmospheric Pollution: Atmospheric Pollution, Ozone Layer, Greenhouse Effect, Water Pollution: Wastewater, Wastewater Treatment.
- Waste: Waste Cycle, Waste Treatment, Recycling and Design Policy.
- Environmental Management Systems: Audit and Observations, Policies and Pragmatism, Non Pollution Strategic Plan
- Energy: Renewable Energy, Energy Saving
- Standards: Quality and Iso 9000, Environment and Iso 14000, Lebanese Legislation on the Environment

LAB Sessions:

Visits to sites: The purpose of visits to industrial sites is to see the applications of the knowledge acquired and to create an internal or external audit approach of the visited entities. In addition the visit report written by group of students will strengthen their ability to write scientific report. For example:

- Drinking water filtration center - Saida - Fawar
- Electricity of Lebanon - Zahrani, toxic emission of the generators
- Wastewater treatment - Saida - Sinik
- Lebanon cable
- Others

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS5ININ	Industrial Automation I	5	3	9	9	12

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Logic Circuit.

Objectives:

The course helps in:

- Providing the student with basic knowledge of the industrial automation systems design, installation, modification, maintenance, and repair.
- Explaining the General function of Industrial Automation.
- Identifying Practical Programmable Logic Controller Applications.
- Recognizing Fundamentals of Programming Including (Programming, Coils, Contacts, Timers and Counters, Logical Program Development).
- Introducing the PLC Programming (Grafcet, Ladder Diagram; Instruction List, and Structured Text).

Contents:

- General description of an industrial automation system.
- PLC: Block diagram of PLC, Major Components of a Common PLC, Input/output module connection, Memory Map Organization, PLC Operation, PLC Communications.
- Description of a sequential automation system using the Sequential Function Chart (SFC).
- PLC Programming Languages: Ladder Diagram (LD), Functional block Diagram (FBD), Structured Text (ST), Instruction List (IL), Sequential Functional Chart (SFC).

LAB Sessions:

- SFC introduction and simulation using Automgen.
- Programming and simulation of a different kind of PLC (EASY, Zelio, Twido, Delta…).
- Real applications on a sequential automation system (Elevator, surface treatment, water tank, objects sorting…).

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS5ORGM	Maintenance Organization	5	4	15	18	12

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

This course defines the characteristics and functions of maintenance in an industrial system and acquires the basic elements for the organization and control of these functions.
Involvement of the maintenance technician in the company.
Establishment of maintenance documentation.
Management of maintenance interventions (preparation, time, costs).
Use of maintenance tools and methods.
Planning of maintenance interventions.
Use of advanced maintenance techniques.
Implementation of a CMMS. Establishment of monitoring and testing procedures

Contents:

Industrial organization of the company.
Position of the maintenance in the company.
Organization and evolution of maintenance.
Maintenance methods: Maintenance operations, Types and levels of maintenance,
Maintenance documentation - Normative references, financial aspects of maintenance, Outsourcing
Failures: mechanisms, analysis, diagnosis, AMDEC,
Dependability of the systems: RMAIS approach (Reliability, Maintainability, Availability, and Intrinsic Safety).
Reliability: behavioral laws.
Advanced maintenance organizations: 5S, TPM, MBF,
Maintenance Scheduling and Support Logistics: Spare Parts and Consumables, Maintenance Inventory Management, Maintenance Contracts.
Maintenance management (CMMS): inventory management, intervention logistics, cost calculation, plans, data, history, documentation.

LAB Sessions:

Model of maintenance: allows learning the concepts and methods, which lead to an improvement of the global efficiency of the equipments (global maintenance). The scenario is based on the analogy between driving a machine and driving a vehicle during an African rally.
Realization of a computer-assisted maintenance management program using a database software (ACCESS) that allows managing interventions, stock management, employee planning.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS5PDEE	Electric Power Production and Distribution	5	3	9	9	12

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Electricity and Magnetism, Electrical Power, Machines and Electrical Actuators I and II

Objectives:

This course is useful in the study and modeling of electrical networks, Electrical energy transmission networks, and power lines networks.

Contents:

Production of electrical energy: renewable energy (solar, wind), thermal and hydraulic energy.
Transport of electrical energy: high voltage transport, three-phase transport, comparison between the various electrical energy transmission systems
Modeling of an electric power transmission line: calculation of inductance parameters, calculation of capacitance parameters, model of a line: short, medium, long, equation and calculation, power balance
Unbalanced systems or unbalanced electrical network: unbalanced load, disconnection of one or more phases, short-circuit fault between phases...
Protection: electrical network faults, protection of alternators, transformers, lines and busbars, cables, motors and distribution transformers, measuring devices.
Stability of the network.

LAB Sessions:

- Power Analyzer: "Qualistar"
- Unbalanced system
- Coupling of two generators
- Improvement of the power factor of an installation
- Neutral regime applications
- Introduction to simulation software (Ecodial, Dialux, ..)
- Design and drawing of electrical schematics on simulation software (Autocad, Ecodial, Dialux, ..)
- Electrical installation: case study (eg residential building)

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS5TMM	Technology and Electrical Maintenance	5	4	12	18	15

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Electricity and Magnetism, Machines and Electrical Actuators I and II.

Objectives:

The course helps the students to:
Discover the Electrical installations and their equipment, in industrial complexes.
Understand the topology of electrical installations, classify and study electrical networks and installations.
Know the methodology of troubleshooting in electromechanical systems (electrical and automatic), and apply them in the maintenance of these systems

Contents:

Electrical installation topology, classification of networks, choice of TT, TN and IT neutral regimes, contact protection (direct, indirect), fault currents, contact voltage, calculation of tripping conditions in IT and TN regimes. Protection of conductors and cables against overcurrent, calculation of conductor cross-sections and cables. Calculation of the short circuits currents, choice of circuit breakers. Electrical components and equipment and conditions of use (circuit breakers, fuses, DDR, contactors, etc.). LV installation, capacitor installation, determination of the optimal transformer power. Lightning arrester and lightning rod, use of asynchronous motors.
General information on maintenance activities.
Verification and control of electronic installations (commissioning, modification and maintenance)
Determination of maintenance levels and type.
Measurement operations and types.
The main symptoms of a short circuit.
Methods of searching faults and types of default.
Maintenance of electrical machines such as asynchronous motors, DC motors and transformers.
Checking the parameters influencing the operation of three-phase asynchronous motors.
Use of documentation (fault history, electrical schematics, Grafcet, etc.) to diagnose the causes of failures.
Troubleshooting and Repairing Failures in Programmable Automated Systems Using Hishikawa Troubleshooting Flowchart and Diagram

LAB Sessions:

Series of practical work related to:
Starting of three-phase asynchronous motors (direct, two-way) with the necessary protections and Y - Δ Started control motor.
Neutral regimes: characteristics and fault currents (TT, TN, IT regimes).
Measurement of the resistance of earth connections. Measurement of isolation.

Series of practical work related to the diagnosis of failure and troubleshooting on asynchronous control panels, single-phase and three-phase, on automatic control systems (elevator or other).

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS5TEMM	Technology and Mechanical Maintenance II	5	4	12	15	18

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Technology and Mechanical Maintenance I.

Objectives:

Be able to read technical specifications, choose components, propose constructive solutions, and choose appropriate tolerances.

Contents:

- Power transmission between shafts in extension (Couplings - Clutches, Brake ...)
- Power transmission with modification of the nature of the movement, system connecting rod / crank and derivatives - cams - eccentric...
- Rotating guidance
- Translational guidance
- Bearings: General Survey - Selection Criteria, Bearing Mounting, Bearing Calculation and Lifespan
- Lubrication - Seals
- Vibration.

Many applications and examples of achievements chosen in modern construction are chosen

LAB Sessions:

- TP 1 Study of a couplings - clutches, brake systems.
- TP 2 Study of cams and eccentric system.
- TP 3 Study of a lubrication system.
- TP 4 Study of a refroidissement system.
- TP 5 Study of synchronization.
- TP 6 Study of bearing assembly and disassembly.

(*)The applied technological character of this course, implies the interference between Courses, Tutorial and Practice.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS5TEMT	Technology and Thermal Maintenance	5	3	9	12	9

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Heat Transfer, Fluid Mechanics and Thermodynamics

Objectives:

By the end of this course, students will be able to:
- define and apply thermodynamics concepts to the heat pump / refrigeration machine (vapor-compression refrigeration system) and its components
- identify refrigerants and accessories used in these machines.
- identify common refrigeration system problems and troubleshooting.

Contents:

Heat Exchangers: Analysis and calculation
Heat pumps and Refrigeration machines.
Heat pump technology.
Refrigerants role and properties
Maintenance of Heat Pumps: Main Causes of Malfunction- Examples of Troubleshooting

LAB Sessions:

Experiment 1: Heat pump.
Experiment 2: Air conditioning.
Experiment 3: Refrigeration machine
Software assignment:
FRIGOBASE: Effective intervention on individual air conditioner
FRIGODEP: Running and troubleshooting of different types of installations, with different refrigerants.
FRIGODIAG: Simulator of refrigeration system failure

Code	Title	Semester	ECTS	Courses	Exercises	I
LS5GEPR	Production Management	5	4	12	18	

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

This course highlights the importance of production management within companies.
The introductory chapter focuses on the main concepts of production management, and deals with the different production strategies as well as the modes of production organization.
Inventory Planning and Management, and Flow Management are then explained as well as the various methods of calculating them, to clarify the importance of production studies and methods, as well as time measurement in production management.
The importance and usefulness of forecasting and Project Management are then presented as well as the production forecasting methods and project scheduling techniques.

Contents:

Introduction

- Brief History of Production Management
- Types of Production Systems
- Flexible production control and Activity management
- Organizational structures

Inventory management

- Inventory Management Fundamentals
- Inventory planning
- Inventory Management Techniques
- Economic Order Quantity model

Flow planning and management

- Flow Planning
- MRP, MRPII
- KANBAN, Just-in-time (JIT) manufacturing
- Lean Manufacturing

Project Management

LAB Sessions:

- Assembly line Simulation and Analysis
- Production process flow analysis
- Inventory management case study
- Flow planning and management case study
- Project Management case study.

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

Departments: MIE-CCNE

Objectives:

This course allows the students to study and implement the basic systems and Microsystems adapted to the requirements of embedded systems and control systems, give the necessary basic knowledge and methodology to achieve correctly the conception of programmable logic device (FPGA, CPLD...) in VHDL. Not only this, the course helps in acquiring how to implement the VHDL language, for the modeling, design and synthesis of digital circuits system with the certainty of achieving a product that meets the specifications that interfere with the electronics.

Contents:

Introduction, Design flow (Presentation of the FPGA, interest, evolution, field of application - Explanation of the FPGA and CPLD architecture, the distribution of the elements and the possibilities of exploitation of these different elements. Logic, embedded memory, clock blocks, DSP blocks, PLL, routing structure etc. Design methodology, tools ... The VHDL language and structures: Introduction to the VHDL language - IEEE libraries - Basic functions - Modular design - Modular decomposition (instantiation) [Data typing (Std_logic_vector) - Design units (entity, architecture, package, configuration) - Signals and ports, processes of a signal, variables vs. signals] - Concurrent and sequential instructions - Structural and behavioral description- GENERATE statement - Functions and procedure - State machine (synchronous and asynchronous) - Memory - Complex sequential systems (VHDL model for a simple microprocessor).

LAB Sessions :

The programmable device - FPGA (Altera DE2).
Practical work and programming VHDL- Getting started with a simulation tool and a synthesis tool VHDL- Programming the FPGA module with the software (Quartus).
Objectives: Realize the synthesis of logical functions in VHDL, Simulate the behavior of the system and to validate the realization on the module (DE2 of Altera) - Programming of an SRAM FPGA module. Examples covered: Multiplexers, Decoders, Segment Display 7, Counters, State Machine, traffic Light Controller, Model for a simple microprocessor, Memory, UART ... Study case: A pair work (each pair work has a different subject) with a part of specifications analysis, a part of functional analysis, the synthesis of the functions using a VHDL description, global simulation then realization on the model for testing and validation. (Proposed subjects: control of a remote system, realization of a high-frequency function generator, sound analysis, telemeter US, sigma-delta converter, sensor and display I2C...

Semester 6

Code	Course	ECTS	Lecture	Exercises	LAB	Total
LS6STAG	Internship	6				
LS6PFDE	Senior Project (≈ 180h/student-project)	12			180	180
LS6DRGT	General and Labor Law (CE-IEM-CCNE-BC)	1	15			15
LS6CSEF	Structural Calculations by Finite Element (CE-IEM)*	3	9	12	9	30
LS6LOGI	Logistics*	3	9	12	9	30
LS6MDMC	Continuum Mechanics*	3	9	12	9	30
LS6SYTH	Thermal System*	3	9	12	9	30
LS6ENRE	Renewable Energy*	3	9	12	9	30
LS6GEQU	Quality Management (CE-IEM)*	3	9	12	9	30
LS6ININ	Industrial Automation II*	3	9	12	9	30
LS6TRIN	Information Processing*	3	9	12	9	30
Total	7	31	51	48	216	315

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6STAG	Internship	6	6	0	0	0

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: 105 credits of the program.

Objective:

To allow a first contact with the professional world and a realization of the technical works of industrial engineering under the supervision of a specialist in the labor market
To allow the student to deepen his knowledge in the field of Industrial Engineering and to carry out studies in a professional environment.

Contents:

Development of industrial and business knowledge in the public or private sector.
Discover the trade by focusing on the study and execution of work on site.
Implementation of the knowledge acquired at the University and benefit from practical training.
A detailed report must be written and supported in front of a jury.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6PRFE	Senior Project	6	12	0	0	180

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: 100 credits of the program.

Objectives:

The course objectives is to draw the achievements of the various disciplines in the field of networks and telecommunications, in a simple project of a professional nature.

Contents:

Project subjects, characterized by their interdisciplinary dimension, are offered to students. A project is proposed by a small group of students led by teachers. Students will apply the acquired techniques and will do the necessary additional research. A report will be written.
A detailed brief must be written and argued before a jury.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6DRGT	General and Labor Law	6	1	15	0	0

epartments: MIE-CCNE-CE-BC

bjectives:

n introduction to General Law and to Labor Code so that future graduates know their rights a ıties while exercising their jobs.

ontents:

troduction to the study of law
ıe juridical rule: Definition – characteristics – sources- principles – classification.
ıe juridical process: courts – arbitration – action – proof modalities.
ontracts and related responsibility: form and content of contract – criminal responsibility – civ sponsibility- contractual responsibility – responsibility of engineers in building sector.

abor code:
ontent and conditions in a labor contract-Labor contract modalities-Obligations of employer a nployee-Warning-Vacations-Risk theory-Abuse-The National Fund of Social Security (NFSS)

سم الاول: مقدمة عن القانون
المبحث الاول: القاعدة القانونية - المبحث الثاني: العقد - المبحث الثالث: الدعوى - المبحث الرابع: التنظ ضائي العام

سم الثاني: قانون العمل
بحث الاول: ماهية قانون العمل وتطوره - المطلب الاول: تعريف قانون العمل- المطلب الثاني: تطو ون العمل.
بحث الثاني: نطاق قانون العمل - المطلب الاول: الاشخاص الخاضعون لأحكام قانون العمل - المطل اني: الفئات المستثناة من الخضوع لأحكام قانون العمل
بحث الثالث: علاقات العمل الفردية - المطلب الاول: تعريف عقد العمل الفردي وبيان خصائصه وعناصر ساسية - المطلب الثاني: إنعقاد عقد العمل الفردي - المطلب الثالث: الآثار المترتبة على عقد العمل الفرد المطلب الرابع: تعليق وإنتهاء عقد العمل الفردي - المطلب الخامس: قضاء العمل الفردي
المبحث الرابع: علاقات العمل الجماعية - المطلب الاول: التنظيم النقابي- المطلب الثاني: عقد العمل الجماء

سم الثالث: الضمان الاجتماعي
المبحث الاول: الصندوق الوطني للضمان الاجتماعي وأجهزته
المبحث الثاني: فرع ضمان المرض والامومة
المبحث الثالث: فرع ضمان طوارئ العمل والامراض المهنية
المبحث الرابع: فرع التقديمات العائلية والتعليمية
المبحث الخامس: فرع تعويض نهاية الخدمة

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6CSEF	Structural Calculations by Finite Element	6	3	9	12	9

Departments: MIE-CE

Pre-requisites: Mechanics I and II, Strength of Materials.

Objectives:

This course helps the students to acquire the basic notions necessary for the calculation of structures subjected to mechanical loading by the finite element method. This course presents the essential characteristics of the finite element method for the study of the behavior of one and two dimensional structures in plane elasticity. It also presents the theoretical and practical aspects of the method.

Contents:

Notions of discretization-mesh, different types of finite elements, degrees of freedom.
Form functions of displacements.
Elementary matrix of rigidity, vector of nodal loads, vector of nodal displacements.
Assembly of elementary matrices, global matrix of rigidity of the structure.
Global equilibrium and resolution of the linear system.
Deformations and constraints.
One-dimensional finite element: bar in tension.
One-dimensional finite element: bending beam.
Two-dimensional triangle finite element with 3 nodes in plane elasticity.
2D quadrilateral finite element with 4 nodes in plane elasticity.

LAB Sessions:

Modeling and calculation of structures using the finite element software by treating the following cases: tensile bar, bending beam, two-dimensional structure with a finite element triangular mesh with 3 nodes in plane elasticity, two-dimensional structure with discretization in elements quadrilateral finish at 4 knots in plane elasticity.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6LOGI	Logistics	6	3	9	12	9

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

After completion of the course, students will be able to:
- Describe and explain the importance of Supply Chain Management to the success of a firm. - Identify the main drivers of SC performance and measure them using precise metrics. - Understand relationship between the concept of strategic fit, the SC strategy and the competitive and how to achieve it.
- Understand situations in which aggregate planning is appropriate and the role it plays in the supply chain.
- Formulate aggregate planning problems as linear programs and solve them using MS Excel.

Contents:

In this course, many important concepts and topics will be discussed:
- Introduction to Supply Chain, importance and main concepts
- Design of Supply Chain and facilities locations
- Stock management
- Data flow in Supply Chain
- Understand pricing and revenue management and their role in the SC.
- Assess the importance of the role played by information technology

LAB Sessions:

Applied software to logistics, Mini-project.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6MDMC	Continuum Mechanics	6	3	9	12	9

Department: Maintenance and Industrial Engineering (MIE)

Objectives:

The aim is to provide a general introduction to the mechanics of continuous media and to address its elementary application to the mechanics of solids and fluids.
At the end of this course, the student must have assimilated the main concepts and laws of this theory (in kinematics and dynamics of deformable environments) and will have to understand its application. In addition, he will have to be able to apply these notions to solving simple analytical problems.

Contents:

- General introduction to continuous media.
- Continuity hypothesis.
- Description of the motion of a continuous medium.
- Deformations.
- Conservation laws of classical mechanics.
- Constraints and equilibrium equations
- Application of the general concepts of Continuous Media Mechanics to deformable solid media:
- Linear elasticity.
- Hypothesis of small disturbances.
- Linear elastic behavior.
- Formulation of general problems of linear elasticity

LAB Sessions:

Thin wall Cylindrical Model.
Thick wall Cylindrical Model.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6SYTH	Thermal system	6	3	9	12	9

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Heat Transfer, Fluid Mechanics, Thermodynamics, Technology and Thermal Maintenance.

Objectives:

This course aims to characterize the different refrigeration systems, air conditioning, heating, components and accessories. Make the student design and size a refrigeration system / air conditioning / heating taking into account the thermal loads and make the choice of equipment. Identify the conditions of thermal comfort. Understand the principle of operation of various types of solar water heating system, the energy balance and thermal efficiency.

Contents:

Cold room Refrigerated Results, component selection
Air Conditioning Principles Conditions of thermal comfort, air conditioning check, winter thermal loads, thermal loads summer.
Air - The System: Air Conditioning Systems Installation Elements
Heating Installations Central heating, heating systems in hot water, steam, hot air, electric, and solar.
Solar water heater: Various solar heating systems: passive / active and open / closed. Various types of solar thermo-sensors. Caloriporteurs fluids. thermal storage unit.

LAB Sessions:

Using Software:
Cold Room: determine the cooling capacity required to operate a cold room
CLIMEAUDEP: Learning of water central air conditioning systems.
HYDRAUDEP: Learning of master the most commonly encountered hydraulic problems on water conditioning systems.
Simsol / TECSOL: calculating the thermal performance of solar systems for hot water.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6ENRE	Renewable energy	6	3	9	12	9

Department: Maintenance and Industrial Engineering (MIE)

Pre-requisites: Electrical Power, Machines and Electrical Actuators I and II, Production and Distribution of Electric Power.

Objectives:

Know the main sources of renewable energy from our natural environment. Solar, wind, geothermal, hydro, biomass and waste energy, energy storage, energy efficiency.

Contents:

Solar photovoltaic energy: Characteristics and performances according to the technology - Silicon cells: mono and poly-crystalline, amorphous - Mineral thin film cells: Silicon, Cd In Si, Cd In Ge Si. - Organic thin film cells...- Estimation of energy needs of the user. Sizing equations. Criteria for choosing the photovoltaic system. System sizing. Installation of photovoltaic fields. Operating and maintenance costs. Environmental impact assessment. Maintenance, recycling of components.
Wind energy: The wind: measurement, modeling, resource evaluation - Wind Turbines: definitions and basic principles. - Technological characteristics of wind turbines: wind turbine with horizontal axis: geometric description, modeling, performances - wind turbine with vertical axis (other types of wind turbines: Darrieus, Savonius, orthopter). - Design and physical characteristics of wind turbines - Description of the different components of wind power generation. - The wind turbines of the future (tidal turbines, Hovering Wing Turbine: flying turbines).
Hydropower: Basic Principles - Different Types of Installation and Operation - Advantages - Disadvantages.
Marine energy: Waves: fundamental equations - Generation mechanisms - Wave energy - Statistical properties: spectral approach (kinetic equation) - The marine energy resource.
Geothermal Energy: Geothermal resources at high and low temperatures. Soil temperature, geothermal gradient, soil properties. Notions of hydrogeology. - Thermal resistance of the wells. Design, dimensioning and simulation of vertical systems.
Other energies: biomass and hydrogen

LAB Sessions:

Simulation (CAD): Design, dimensioning and modeling of a photovoltaic system.
Measurement of current, voltage and power calculation of a solar panel.
Perform a series of electrical measurements on a photovoltaic system

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6GEQU	Quality Management	6	3	9	12	9

Departments: MIE-CE

Objectives:

Today the economic and competitive environment of the company is tense. The supply is often greater than the demand, the solution that proves possible is to offer products and / or services better than the competitors to ensure its durability and survival. As a result, quality can be considered as the most competitive strategic variable of competitiveness. First, this course will clarify the concept of quality and its history, quality control, quality assurance and total quality management. In the second place, we will see the interest of a customer listening approach. Thirdly, we will discover a variety of quality tools, and how to improve quality management with ISO certification. Finally, this course will present the six sigma approach and risk management.

Contents:

History of the quality approach
Quality control
Quality assurance:
Total Quality (Q.T) or Total Quality Management (TQM)
The customer listening process
1) Identification of customer needs and expectations
2) Customer satisfaction surveys
3) The collection of complaints
4) The Action Plan (The Deming Wheel Principle)
The tools applicable to quality management
1) The QQOQCCP:
2) II. Brainstorming
3) THE WEIGHTED VOTE
4) Multi-criteria weighted voting
5) Cause and Effect Diagram (ISHIKAWA)
6) The 5S method
ISO 9001 certification
Six Sigma and Risk Management

LAB Session:

Lab N° 1: Evolution of the cost of quality. Lab N° 2: Application Pareto diagram. Lab N° 3: ISHIKAWA Diagram Application (Excel Template + Add-in). Lab N° 4: Quality Management Tools.

Code	Title	Semester	ECTS	Courses	Exercises
LS6ININ	Industrial Automation II	6	3	9	12

epartment: Maintenance and Industrial Engineering (MIE)

·e-requisites: Industrial Automation I.

bjectives:

- At the end of this course, students must be aware of the implementation structure of industrial automation system.
- Knowing the implementation methods of a wired technology.
- Be familiar with the different PLC programming languages.
- Knowing the implementation methods of an SFC on Micro-controller.

ontents:

- Resume of PLC programming Languages
- SFC implementation over electromagnetic relays and Flip-Flop
- SFC advanced Structure: series-parallel and parallel-series conversion, Master-slave.
- SFC implementation over Microcontroller (PIC 16F877)

AB Sessions:

plications over different industrial automation systems:

- Elevator equipped with an encoder.
- Water tank system with Pump Priorities.
- Automatic objects sorting.
- Building and Management System.
- PLC programming and communication with Touch Screen and VFD.
- SFC implementation over PIC 16F877.

Code	Title	Semester	ECTS	Courses	Exercises	LAB
LS6TRIN	Information Processing	6	3	9	12	9

Department: Maintenance and Industrial Engineering (MIE).

Objectives:

This course allows to acquire the basic tools needed for the signal processing the design of digital systems.

Contents:

Signal Processing

- Continuous signal
  - ✓ Signals and systems (Definitions, Classification of signals, Common models and mathematical tools)
  - ✓ Harmonic analysis of periodic signals (Fourier Series)
  - ✓ Spectral analysis of non-periodic signals (Fourier Transform)
- Digital Signal
  - ✓ Digitization of signals (Sampling, Quantization)
  - ✓ Spectral analysis of digital signals (Discrete Fourier Transform, Windowing)

LAB Sessions:

- Matlab applications (9h)

Head of department
Industrial and Maintenance Engineering
Pr. Nazir CHEBBO

Faculty of Technology [illegible]
MOHAMMAD HAJJA