الجمهورية الجزائرية الديمقراطية الشعبية
People's Democratic Republic of Algeria
وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education and Scientific Research

University of Medea

LOGO

L.M.D. ACADEMIC PROGRAM OFFERING

Academic Bachelor's Degree

NATIONAL PROGRAM
2025– 2026

(Update 3)

Establishment	Faculty / Institute	Department
University of Medea	**Faculty of Technology**	**Department of Electrical Engineering**

Domain	Field	Specialty:
Science and Technologies	***Automatic***	***Automatic***

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اللجنة البيداغوجية الوطنية
لميدان العلوم و التكنولوجيا
National Pedagogical Committee of the Science and Technology Field

عرض تكوين
ل. م . د
ليسانس أكاديمية

برنامج وطني
2520 -2026

المؤسسة	الكلية/ المعهد	القسم
جامعة المدية	كلية التكنولوجيا	قسم الهندسة الكهربائية

الميدان	الفرع	التخصص
علوم و تكنولوجيا	آلية	آلية

– Semester organisation sheets for courses of the specialty

Semester 1

Course Unit	Materials	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
	Entitled			Courses	TUTORIAL	PRACTICAL WORK			Continuous assessment	Exam
Core UE Code: UEF 1.1.1 Credits: 10 Coefficients: 5	Analysis 1	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
	Algebra 1	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
Core UE Code: UEF 1.1.2 Credits: 12 Coefficients: 6	Mechanical element	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
	Structure of matter	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
Methodological UE Code: EMU 1.1 Credits: 6 Coefficients: 4	Practical work mechanical elements	2	1			1.5 hours	22.5 hours	22.5 hours	100%	
	Practical work structure of matter	2	1			1.5 hours	22.5 hours	22.5 hours	100%	
	Computer Architecture and Applications	2	2	1.5 hours		1 hour	37.5 hours	22.5 hours	40%	60%
E Transversal Code: UET 1.1 Credits: 2 Coefficients: 2	Ethical and deontological dimension (the foundations)	1	1	1.5 hours			22.5 hours	2.5 hours		100%
	Careers in science and technologies	1	1	1.5 hours			22.5 hours	2.5 hours		100%
Semester 1 total		**30**	**17**	**9 hours**	**12 hours**	**4 hours**	**375 hours**	**375 hours**		

Semester 2

Course Unit	Materials	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
	Entitled			Courses	TUTORIAL	PRACTICAL WORK			Continuous assessment	Exam
Core UE Code: UEF 1.2.1 Credits: 10 Coefficients: 5	Analysis 2	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
	Algebra 2	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
Core UE Code: UEF 1.2.2 Credits: 12 Coefficients: 6	Electricity and magnetism	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
	Thermodynamics	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
Methodological UE Code: EMU 1.2 Credits: 6 Coefficients: 4	Practical work Electricity and magnetism	2	1			1.5 hours	22.5 hours	22.5 hours	100%	
	Thermodynamics Lab	2	1			1.5 hours	22.5 hours	22.5 hours	100%	
	Introduction to programming	2	2	1.5 hours		1 hour	37.5 hours	22.5 hours	40%	60%
Transversal UE Code: UET 1.2 Credits: 2 Coefficients: 2	Free - open source software	2	2	1.5 hours	1.5 hours		45 hours	5 hours	40%	60%
Semester 2 total		**30**	**17**	**9 hours**	**22.5 hours**	**5.5 hours**	**375 hours**	**375 hours**		

Semester 3

Course Unit	Materials	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
	Entitled			Courses	TUTORIAL	PRACTICAL WORK			Continuous assessment	Exam
Core UE Code: UEF 2.1.1 Credits: 10 Coefficients: 5	Analysis 3	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
	Waves and vibrations	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
Core UE Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Fundamental Electronics 1	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
	Fundamental Electrical Engineering 1	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
Methodological UE Code: EMU 2.1 Credits: 10 Coefficients: 6	Probability and statistics	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
	Python Programming	2	2	1.5 hours		1.5 hours	45 hours	30:00 pm	40%	60%
	Electronics and Electrical Engineering Practical Work	2	1			1.5 hours	22.5 hours	22.5 hours	100%	
	Waves and Vibrations	2	1			1 hour	3 hours	3 hours	100%	
Discovery UE Code: UED 2.1 Credits: 2 Coefficients: 2	Energy and environment	1	1	1.5 hours			22.5 hours	2.5 hours		100%
	State of the art of electrical engineering	1	1	1.5 hours			22.5 hours	2.5 hours		100%
Semester 3 total		**30**	**17**	**12 hours**	**9 hours**	**4 hours**	**375 hours**	**375 hours**		

Semester 4

Course Unit	Entitled	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
				Courses	TUTORIAL	PRACTICAL WORK			Continuous assessment	Exam
Core UE Code: UEF 2.2.1 Credits: 10 Coefficients: 5	Linear Continuous-Time Control Systems	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
	Combinatorial logic and sequential	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
Core UE Code: UEF 2.2.2 Credits: 6 Coefficients: 3	Signal theory	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
	Automated Systems Architecture	2	1	1.5 hours			22.5 hours	27.5 hours		100%
Methodological UE Code: EMU 2.2 Credits: 12 Coefficients: 7	Numerical methods	5	3	1.5 hours	1.5 hours	1.5 hours	67.5 hours	82.5 hours	40% (20%TUTORIAL+20%PRACTICAL WORK)	60%
	Electrical and electronic measurements	3	2	1.5 hours		1 hour	37.5 hours	22.5 hours	40%	60%
	PRACTICAL WORK Linear Continuous-Time Control Systems	2	1			1.5 hours	22.5 hours	22.5 hours	100%	
	Combinatorial Logic Lab and sequential	2	1			1.5 hours	22.5 hours	22.5 hours	100%	
Transversal UE Code: UET 2.2 Credits: 2 Coefficients: 2	Information and communication technologies	2	2	1.5 hours	1.5 hours Workshop		45 hours	5 hours	40%	60%
Total Semester 4		**30**	**17**	**22.5 hours**	**7.5 hours**	**7 hours**	**375 hours**	**375 hours**		

Semester 5

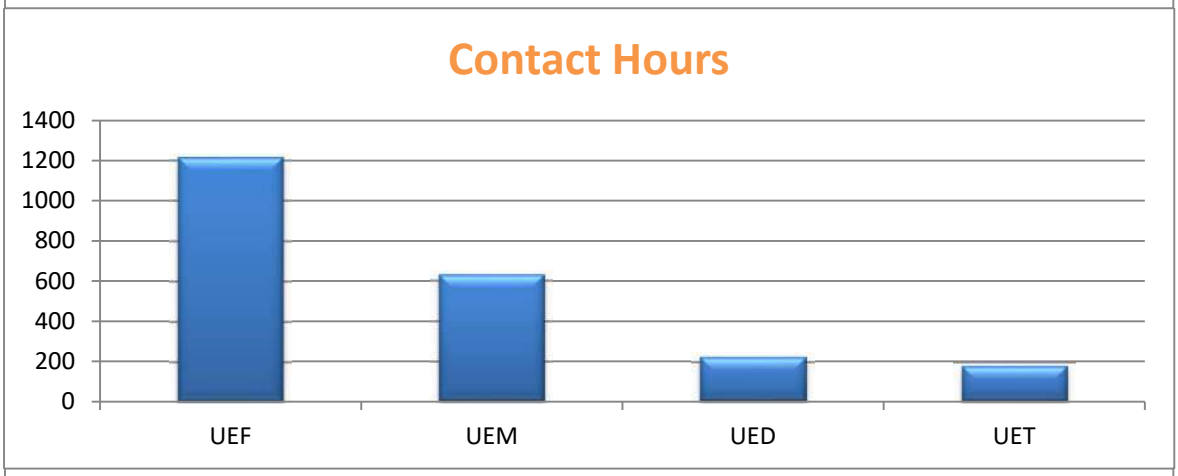
Course Unit	Entitled	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
				Courses	TUTORIAL	PRACTICAL WORK			Continuous assessment	Exam
Core UE Code: UEF 3.1.1 Credits: 10 Coefficients: 5	Linear System Control	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
	Power Electronics	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
	Modeling and identification of systems	2	1	1.5 hours			22.5 hours	27.5 hours		100%
Core UE Code: UEF 3.1.2 Credits: 8 Coefficients: 4	Microprocessors and Microcontrollers	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
	C++ programming	2	1	1.5 hours			22.5 hours	27.5 hours		100%
Methodological UE Code: EMU 3.1 Credits: 9 Coefficients: 5	PRACTICAL WORK Linear System Control	2	1			1.5 hours	22.5 hours	27.5 hours	100%	
	PRACTICAL WORK Power Electronics	2	1			1.5 hours	22.5 hours	27.5 hours	100%	
	PRACTICAL WORK Modeling and Identification of Systems	2	1			1.5 hours	22.5 hours	27.5 hours	100%	
	PRACTICAL WORK Microprocessors and Microcontrollers	2	1			1.5 hours	22.5 hours	27.5 hours	100%	
	Practical work programming in C++	1	1			1 hour	3 hours	10:00 a.m.	100%	
Discovery UE Code: UED 3.1 Credits: 2 Coefficients: 2	Standards & Certification	1	1	1.5 hours			22.5 hours	2.5 hours		100%
	Electrical Safety	1	1	1.5 hours			22.5 hours	2.5 hours		100%
Transversal UE Code: UET 3.1 Credits: 1 Coefficients: 1	Simulation Software	1	1	1.5 hours			22.5 hours	2.5 hours		100%
Total Semester 5		**30**	**17**	**12 hours**	**6 hours**	**7 hours**	**375 hours**	**367.5 hours**		

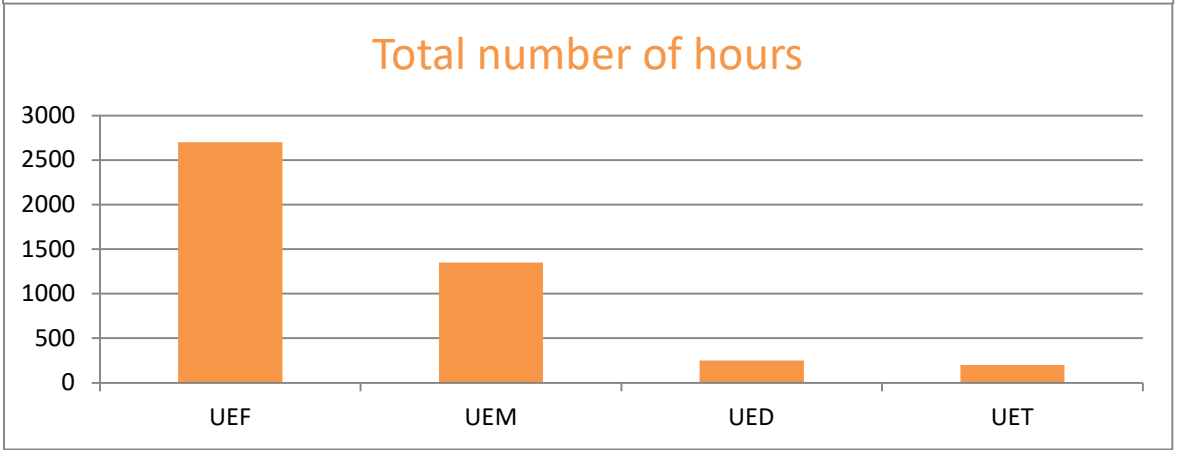
Semester 6

Course Unit	Entitled	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
				Courses	TUTORIAL	PRACTICAL WORK			Continuous assessment	Exam
Core UE Code: UEF 3.2.1 Credits: 10 Coefficients: 5	Sampled-Data Control Systems	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
	Actuators	4	2	1.5 hours	1.5 hours		45 hours	55 hours	40%	60%
	Sensors and measurement chains	2	1	1.5 hours			22.5 hours	27.5 hours		100%
Core UE Code: UEF 3.2.2 Credits: 8 Coefficients: 4	Programmable logic controllers	6	3	1.5 hours	3 hours		67.5 hours	82.5 hours	40%	60%
	Communication Buses and Industrial Networks	2	1	1.5 hours			22.5 hours	27.5 hours		100%
Methodological UE Code: EMU 3.2 Credits: 9 Coefficients: 5	End of Cycle Project	4	2			2h30	37.5 hours	42.5 hours	100%	
	PRACTICAL WORK Sensors and Actuators	2	1			1.5 hours	22.5 hours	27.5 hours	100%	
	PRACTICAL WORK Programmable Logic Controllers	2	1			1.5 hours	22.5 hours	27.5 hours	100%	
	PRACTICAL WORK Communication Buses and Industrial Networks	1	1			1.5 hours	22.5 hours	22.5 hours	100%	
Discovery UE Code: UED 3.2 Credits: 2 Coefficients: 2	Electrical installations in automatic	1	1	1.5 hours			22.5 hours	2.5 hours		100%
	Maintenance and reliability	1	1	1.5 hours			22.5 hours	2.5 hours		100%
Transversal UE Code: UET 3.2 Credits: 1 Coefficients: 1	Entrepreneurship and start-ups	1	1	1.5 hours			22.5 hours	2.5 hours		100%
Semester Total 6		**30**	**17**	**12 hours**	**6 hours**	**7 hours**	**375 hours**	**375 hours**		

Overall summary of the training:

EU / VH	UEF	EMU	UED	UET	Total
Courses	720 hours	120 hours	225 hours	180 hours	1245 hours
TUTORIAL	495 hours	22.5 hours	---	---	517.5 hours
PRACTICAL WORK	---	487.5 hours	---	---	487.5 hours
Personal work	1485 hours	720 hours	25 hours	8 hours	2250 hours
Other (specify)	---	---	---	---	---
Total	2700 hours	1350 hours	250 hours	200 hours	4500 hours
Credits	108	54	10	8	180
% in credits for each UE	60 %	30 %	10 %		100 %





III - Detailed programme by subject

Semester: 1
Course Unit: UEF 1.1.1
Subject 3: Analysis 1
VHS: 67.5 hours (Lecture: 1.5 hours, TUTORIAL: 3 hours)
Credits: 6
Coefficient: 3

Prerequisites:
Basic notions of mathematics in the final year of high school (sets, functions, equations, etc.).

Teaching objectives
This first subject of Analysis I is devoted in particular to the homogenization of students' knowledge at the entrance to the university. The first new elements are taught in a progressive way in order to lead students towards more advanced mathematics. The concepts covered in this subject are fundamental and among the most used in the field of Science and Technology.

Material content:

Chapter 1: Properties of the R set

1. Increased, reduced and limited part.
2. Maximum element, minimum element.
3. Upper bound, lower bound.
4. Absolute value, whole part.

Chapter 2: Real Numerical Sequences

1. Converging sequences.
2. Comparison theorems.
3. Monotonic convergence theorem.
4. Sequences extracted.
5. Adjacent Suites.
6. Special sequences (arithmetic, geometric, recurrent)

Chapter 3: Single-variable real functions

1. Limitations and continuity of functions
2. Derivative and differential of a function
3. Applications to elementary functions (power, exponential, hyperbolic, trigonometric and logarithmic)

Chapter 4: Limited Development

1. Limited development
2. Taylor's formula
3. Limited Feature Development

Chapter 5: Simple Integrals

1 Reminders on the Riemann integral and on the calculus of primitives.

Method of evaluation:

CC: 40%,Final exam: 60%

Bibliographical references:

1- K. Allab, Eléments d'analyse, Fonction d'une variable réelle, 1re& 2e années d'université, Office des Publications universitaires.
2- J. Rivaud, Algèbre : Classes préparatoires et Université Tome 1, Exercices avec solutions, Vuibert.
3- N. Faddeev, I. Sominski, Recueil d'exercices d'algèbre supérieure, Edition de Moscou

Semester: 1
Course Unit: UEF 1.1.2
Subject 3: Algebra 1
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Prerequisites:
Basic notions of mathematics in the final year of high school (sets, functions, equations, etc.).

Teaching objectives
This first subject of Algebra I is devoted in particular to the homogenization of students' knowledge at the entrance to university. The first new elements are taught in a progressive way in order to lead students towards more advanced mathematics. The concepts covered in this subject are fundamental and among the most used in the field of Science and Technology.

Material content:

Chapter 1.Sets, Relationships, and Applications (5 weeks)

1. Set theory.
2. Relation of order, relations of equivalence.
3. Injective, surjective, bijective application and reciprocal function: definition of an application, direct image, reciprocal image, characteristic of an application.

Chapter 2: Complex Numbers (5 weeks)

1. Definition of a complex number.
2. Representation of a complex number: Algebraic representation, trigonometric representation, geometric representation, exponential representation.
3. Roots of a complex number: square roots, solving the equation, $az^2 + bz + c =$ 0nth roots of a complex number.

Chapter 3: Vector Space (5 weeks)

1. Vector space, base, dimension (definitions and elementary properties).
2. Linear map, kernel, image, rank.

Method of evaluation:
CC: 40%, Final exam: 60%

Bibliographical references:

1. J. Rivaud, Algèbre : Classes préparatoires et Université Tome 1, Exercices avec solutions, Vuibert.
2. N. Faddeev, I. Sominski, Recueil d'exercices d'algèbre supérieure, Edition de Moscou
3. M. Balabne, M. Duflo, M. Frish, D. Guegan, Géométrie – 2^{e} année du 1er cycle classes préparatoires, Vuibert Université.
4. B. Calvo, J. Doyen, A. Calvo, F. Boshet, Exercices d'algèbre, 1er cycle scientifique préparation aux grandes écoles 2^{e} année, Armand Colin – Collection U.

Semester: 1
Course Unit: UEF 1.1.3
Material: Mechanical element
VHS: 67.5 hours (Lecture: 1.5 hours, TUTORIAL: 3 hours)
Credits: 6
Coefficient: 3

Prerequisites:
It is recommended to have a good command of physical sciences and basic mathematics in secondary school

Objectives:
The teaching of this subject allows the student to acquire the fundamental notions of classical mechanics related to the material point through:
- kinematics
- Dynamics
- and the concepts of work and energy.

Subject content: Physics 1 (Mechanics)

Chapter I: Reminder
- Dimensional analysis
- Vector analysis

Chapter II: Kinematics
- Notion of Repository
- Study of movements in space (general, circular, rectilinear, intrinsic coordinates)
- Coordinate systems (Cartesian, polar, cylindrical, spherical)
- Relative motion (laws of composition of velocities and accelerations)

Chapter III: Dynamics
- Principle of inertia, Mass of inertia and Galilean frame of reference
- Momentum – Principle of conservation of momentum
- Notion of Force,
- Newton's laws
- Differential equation of motion
- Different types of force (gravitational, elastic, viscous,...)

Chapter IV: Rotational Motion
- Angular momentum, Moment of a Force
- Angular Momentum Theorem and Moment of Inertia
- Applications: Torsion, Pendulum,...

Chapter V: Work, Power, Energy
- Work and power of a force
- Kinetic energy
- Potential energy (gravitational, elastic,...) and equilibrium states.
- Conservative and non-conservative forces.
- Energy conservation.
- Impulse and shock (elastic and inelastic)

Evaluation method:
CC: 40%, Final exam: 60

Semester: 1
Course Unit: UEF 1.1.4
Matter 3: Structure of Matter
VHS: 67h00 (Lecture: 1.5 hours, TUTORIAL: 3 hours)
Credits: 6
Coefficient: 3

Teaching objectives

The teaching of this subject allows the student to acquire the basic formalisms in chemistry, particularly within the matter describing the atom and the chemical bond, the chemical elements and the periodic table with energy quantization. To make students better able to solve chemistry problems.

Recommended Prior Knowledge

Basic notions of mathematics and general chemistry.

Material content:

Chapter 1: Fundamentals (2 weeks)

Macroscopic states and characteristics of states of matter, changes in states of matter, notions of atom, molecule, mole and Avogadro number, unit of atomic mass, atomic and molecular molar mass, molar volume, Weight law: Conservation of mass (Lavoisier), chemical reaction, Qualitative aspect of matter, Quantitative aspect of matter.

Chapter 2: Main constituents of the material (3 weeks)

Introduction: Faraday's experiment: relationship between matter and electricity**,** Demonstration of the constituents of matter and therefore of the atom and**,** some physical properties (mass and charge), Rutherford's planetary model, Presentation and characteristics of the atom (Symbol, atomic number Z, mass number A, number of protons, neutrons and electron), Isotopy and relative abundance of the different isotopes, Isotope separation and determination of the atomic mass and average mass of an atom: Mass spectrometry: Bainbridge spectrograph, Binding and cohesion energy of nuclei, Stability of nuclei.

Chapter 3: Radioactivity – Nuclear Reactions (2Weeks)

Natural radioactivity (α, β and γ radiation), Artificial radioactivity and nuclear reactions, Kinetics of radioactive decay, Applications of radioactivity.

Chapter 4: Electronic structure of the atom (2Weeks)

Wave-particle duality, Interaction between light and matter, Bohr atomic model: hydrogen atom, The hydrogen atom in wave mechanics, Polyelectronic atoms in wave mechanics.

Chapter 5: Periodic Classification of Elements (3 weeks)

D. Mendeleev's periodic classification, Modern periodic classification, Evolution and periodicity of the physico-chemical properties of the elements, Calculation of rays (atomic and ionic), successive ionization energies, electron affinity and electronegativity (Mulliken's scale) by Slater's rules.

Chapter 6: Chemical Bonds (3 weeks)

Covalent bonding in Lewis theory, Polarized covalent bonding, dipole moment and partial ionic character of bonding, Geometry of molecules: Gillespie's theory or VSEPR, Chemical bonding in the quantum model.

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references

1. Ouahes, Devallez, Chimie Générale, OPU.
2. S.S. Zumdhal& coll., Chimie Générale, De Boeck Université.
3. Y. Jean, Structure électronique des molécules : 1 de l'atome aux molécules simples, 3e édition, Dunod, 2003.
4. F. Vassaux, La chimie en IUT et BTS.
5. A. Casalot& A. Durupthy, Chimie inorganique cours 2ème cycle, Hachette.
6. P. Arnaud, Cours de Chimie Physique, Ed. Dunod.
7. M. Guymont, Structure de la matière, Belin Coll., 2003.
8. G. Devore, Chimie générale : T1, étude des structures, Coll. Vuibert, 1980.
9. M. Karapetiantz, Constitution de la matière, Ed. Mir, 1980.

Semester: 1
Course Unit: UEM 1.1.1
Material: Practical work Mechanical element
VHS: 22.5 hours (PRACTICAL WORK: 3:00 AM)
Credits: 2
Coefficient: 1

Prerequisites:
It is recommended to have a good command of physical sciences and basic mathematics in secondary school

Objectives:
The teaching of this subject allows the student to acquire the fundamental notions of classical mechanics related to the material point through:
- kinematics
- Dynamics
- and the concepts of work and energy.

Physics Practical Work 1:

- Measurement and calculation of uncertainties
- Free fall
- Inclined plane
- Circular movement
- Single pendulum
- Oscillating pendulum
- Solid-solid friction

Evaluation method:
Continuous assessment: 100%;

Semester: 1
Course Unit: UEM 1.1.2
Subject 3: Practical work Structure of the material
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives

The teaching of this subject allows the student to acquire the basic formalisms in chemistry, particularly within the matter describing the atom and the chemical bond, the chemical elements and the periodic table with energy quantization. To make students better able to solve chemistry problems.

Recommended Prior Knowledge

Basic notions of mathematics and general chemistry.

Practical work "Structure of matter"

Lab N° 1: Preliminary lab: Safety in the chemistry laboratory and description of the equipment and glassworks.
Lab N° 2: Change of state of water: Passage from liquid to solid state and from liquid state to vapor state.
Lab N° 3: Determination of the quantity of material.
Lab N° 4: Determination of molecular weight.
Lab N° 5: Uncertainty calculation - Determination of ionic radius
Lab N° 6: Determination of partial molar volumes in a binary solution.
Lab N° 7: Qualitative analysis of Cations (1st, 2nd, 3rd and 4th group).
Lab N° 8: Qualitative analysis of Anions.
Lab N° 9: Identification of metal ions by the flame method
Lab N°10: Separation and recrystallization of benzoic acid.
PRACTICAL WORK N°11: Construction and study of some compact structures.
Lab N°12: Study of ionic structures

Evaluation method:

Continuous assessment: 100%;

Bibliographical references

1. Ouahes, Devallez, Chimie Générale, OPU.
2. S.S. Zumdhal& coll., Chimie Générale, De Boeck Université.
3. Y. Jean, Structure électronique des molécules : 1 de l'atome aux molécules simples, 3e édition, Dunod, 2003.
4. F. Vassaux, La chimie en IUT et BTS.
5. A. Casalot& A. Durupthy, Chimie inorganique cours 2ème cycle, Hachette.
6. P. Arnaud, Cours de Chimie Physique, Ed. Dunod.
7. M. Guymont, Structure de la matière, Belin Coll., 2003.
8. G. Devore, Chimie générale : T1, étude des structures, Coll. Vuibert, 1980.
9. M. Karapetiantz, Constitution de la matière, Ed. Mir, 1980.

Semester: 1
Course Unit: UEM 1.1.3
Subject 3: Computerstructure and applications
VHS: 45 hours (Lecture: 1.5 hours, PRACTICAL WORK: 1 hour)
Credits: 2
Coefficient: 2

Objective and recommendations:
The objective of the subject is to allow students to learn to program with an evolved language (Fortran, Pascal or C). The choice of language is left to the discretion of each institution. The notion of algorithm must be implicitly supported during language learning.

Recommended Prior Knowledge
Basics of Web technology.

Material content:
Part 1. Introduction to Computer Science (5 weeks)
1- Definition of computer science
2- Evolution of computers and computers
3- Information coding systems
4- How a computer works
5- Hardware part of a computer
6- System part
Basic systems (operating systems (Windows, Linux, Mac OS,...)
Programming languages, application software

Part 2. Notions of algorithm and program (10 weeks)
1- Concept of an algorithm
2- Representation in organizational chart
3- Structure of a program
4- The approach and analysis of a problem
5- Data structure: Constants and variables, Data types
6- Operators: assignment operator, relational operators, logical operators, arithmetic operations, priorities in operations
7- Entry/exit operations
8- Control structures: Conditional control structures, Repetitive control structures

Computer Science 1 :
The purpose of the practical work is to illustrate the concepts taught during the course. The latter must start with the courses according to the following schedule:
• Practical work to introduce and familiarize yourself with the computer machine from a hardware and operating system point of view (exploration of the different functionalities of OS)
• Practical work to learn how to use a programming environment (Editing, Assembly, Compilation, etc.)
• Practical work of applying the programming techniques seen in class.

Evaluation method:
Continuous assessment: 40%; Examination: 60%.

Bibliographical references
1- John Paul Mueller et Luca Massaron, Les algorithmes pour les Nuls grand format, 2017.
2- Charles E. Leiserson, Clifford Stein et Thomas H. Cormen, Algorithmique: cours avec 957 exercices et 158 problèmes, 2017.
3- Thomas H. Cormen, Algorithmes: Notions de base, 2013.

Semester: 1
Course Unit: UET 1.1.1
Subject: Ethical and deontological dimension (the foundations)
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

The main objective of this course is to facilitate an individual's immersion in student life and their transition into a responsible adult. It helps to develop students' awareness of ethical principles. To introduce them to the rules that govern life at the university (their rights and obligations vis-à-vis the university community) and in the world of work, to raise awareness of the respect and valuation of intellectual property and to explain to them the risks of moral ills such as corruption and how to combat them.

Recommended prior knowledge:

None

Material content:

I. Fundamentals – مفاهم أساسية (2 weeks)

Definitions:
1. Moral:
2. Ethics:
3. "Theory of Duty" Ethics:
4. The law:

5. Distinction between the different concepts
   A. Distinction between ethics and morality
   B. Distinction between ethics and professional conduct

II. The Frameworks – المرجعيات (2 weeks)

Philosophical references
The religious reference
The Evolution of Civilizations
The institutional reference

III. The University Franchise – الحرم الجامعي (3 weeks)

The Concept of University Franchises
Regulatory Instruments
University Franchise Royalties
University campus stakeholders

IV. University Values – القيم الجامعية(2 weeks)

Social values
Community Values
Professional Values

V. Rights and Duties (2 weeks)

Student Rights
Student Duties
Teachers' rights
Duties of the research professor
Obligations of administrative and technical staff

VI. University Relations (2 weeks)

Definition of the concept of university relations
Student-Teacher Relations
Student-student relationship
Student-Staff Relations
Student-Association Member Relationship

VII. Practices (2 weeks)

Good practices For the teacher
Good practices For the student

Evaluation method:

Exam: 100%.

Bibliographical references

1. Recueil des cours d'éthique et déontologie des universités algériennes.
2. BARBERI (J.-F.), 'Morale et droit des sociétés', *Les Petites Affiches,* n° 68, 7 juin 1995.
3. J. Russ, *La pensée éthique contemporaine*, Paris, puf, *Que sais-je ?,* 1995.
4. LEGAULT, G. A., Professionnalisme et délibération éthique, Québec, Presses de l'Université du Québec, 2003.
5. SIROUX, D., 'Déontologie', dans M. Canto-Sperber (dir.), Dictionnaire d'éthique et de philosophie morale, Paris, Quadrige, 2004.
6. Prairat, E. (2009). Les métiers de l'enseignement à l'heure de la déontologie. *Education et Sociétés, 23*.
7. https://elearning.univ-annaba.dz/pluginfile.php/39773/mod_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ontologie.pdf .

Semester: 1
Course Unit: UED 1.1.1
Subject 3: Careers in science and technology
VHS: 22.5 hours (Lesson: 1.5 hours)
Credits: 1
Coefficient: 1

Prerequisites: None

Objectives:
In the first stage, the student will be introduced to all the courses that are covered by the Science and Technology Field, and in the second stage, a wide range of professions to which these courses lead. In the same context, this subject introduces the new challenges of sustainable development as well as the new professions that can result from it.

Content of the material:

1.What is engineering sciences?
The engineering profession, history and challenges of the 21st century**,** Search for a profession/a recruitment ad by keyword, develop a simple job description (job Entitled, company, main activities, skills required (knowledge, know-how, interpersonal skills, etc.)

2. Courses in Electronics, Telecommunications, Biomedical Engineering, Electrical Engineering, Electromechanics, Optics & Precision Mechanics:
- Definitions, fields of application (Home automation, embedded applications for automotive, Video surveillance, Mobile telephony, Fiber optics, Advanced scientific instrumentation, Medical imaging and instrumentation, Giant mirrors, Contact lenses, Transmission and Distribution of electrical energy, Power generation plants, Energy efficiency, Maintenance of industrial equipment, Elevators, Wind turbines, ...
- Role of the specialist in these areas.

3. Automation and Industrial Engineering courses: - Definitions, fields of application (Industrial Automated Lines, Numerical Control Machine Tools, Robotics, Inventory Management, Goods Traffic Management, Quality, - Role of the specialist in these fields.

4. Process Engineering, Hydrocarbons and Petrochemical Industries:
- Definitions, Pharmaceutical industry, Food industry, Leather and textile industry, Biotechnology, Chemical and petrochemical industry, Plastics processing, Energy sector (oil, gas), ...
- Role of the specialist in these areas.

1. Industrial Health and Safety (HSI) and Mining Engineering sectors :
- Definitions and fields of application (Safety of goods and people, Environmental problems, Exploration and exploitation of mining resources, etc.)
- Role of the specialist in these areas.

2.HVAC and Transport Engineering - Definitions, fields of application (Air Conditioning, Smart Buildings, Transport Safety, Traffic Management and Road, Air and Naval Transport, etc.)
- Role of the specialist in these areas.

3. Courses in Civil Engineering, Hydraulics and Public Works :(2 weeks)
- Definitions and fields of application (Construction materials, Large road and rail infrastructures, Bridges, Airports, Dams, Drinking water supply and sanitation, Water flows, Water resources management, Public works and Spatial planning, Smart cities, etc.)
- Role of the specialist in these areas.

4. Aeronautics, Mechanical Engineering, Marine Engineering and Metallurgy Sector:
- Definitions and fields of application (Aeronautics, Avionics, Automotive industry, Ports, Breakwaters, Industrial equipment production, Steel industry, Metal processing, etc.)
- Role of the specialist in these areas.

Group work : Preparation of job descriptions for professions in each sector based on recruitment advertisements found on job application sites (e.g. **htPractical Work: //www.onisep.fr/Decouvrir-les-metiers**, www.indeed.fr, **www.pole-emploi.fr**) (1 Field / group).
Depending on the capacities of the institutions, recommend calling on doctoral students and former graduates of the institution in a tutoring/mentoring system where each group can call on its tutor/mentor to develop the job description/discover the different professions of the ST.

Personal work of the student for this subject:
The teacher in charge of this subject can let his students know that he can always evaluate them by offering them to prepare job descriptions. Ask students to watch a popular science film related to the chosen profession at home (after having given them either the film on electronic media or having indicated the internet link to this film) and then ask them to submit a written report or to make an oral presentation of the summary of this film, … etc. The improvement of these activities is left to the discretion of the teacher and the training team, who are the only ones able to define the best way to take this personal work into account in the overall mark of the final exam.

Evaluation method:
Exam: 100%.

Bibliographical references:

[1] Quels métiers pour demain ? Éditeur : ONISEP, 2016, Collection : Les Dossiers.
[2] J. Douënel et I. Sédès, Choisir un métier selon son profil, Editions d'Organisation, Collection : Emploi & carrière, 2010.
[3] V. Bertereau et E. Ratière, Pour quel métier êtes-vous fait ? Editeur : L'Étudiant, 6e édition, Collection : Métiers, 2015.
[4] Le grand livre des métiers, Éditeur : L'Étudiant, Collection : Métiers, 2017.
[5] Les métiers de l'industrie aéronautique et spatiale, Collection : Parcours, Edition : ONISEP, 2017.
[6] Les métiers de l'électronique et de la robotique, Collection : Parcours, Edition : ONISEP, 2015.
[7] Les métiers du bâtiment et des travaux publics, Collection : Parcours, Edition : ONISEP, 2016.
[8] Les métiers du transport et de la logistique, Collection : Parcours, Edition : ONISEP, 2016.
[9] Les métiers de l'énergie, Collection : Parcours, Edition : ONISEP, 2016.
[10] Les métiers de la mécanique, Collection : Parcours, Edition : ONISEP, 2014.
[11] Les métiers de la chimie, Collection : Parcours, Edition : ONISEP, 2017.
[12] Les métiers du Web, Collection : Parcours, Edition : ONISEP, 2015.

Semester: 2
Course Unit: UEF 1.2.1
Material: Analysis 2
VHS: 67.5 hours (Lecture: 1.5 hours, TUTORIAL: 3 hours)
Credits: 6
Coefficient: 3

Prerequisites:
It is recommended to master the fundamental basics of calculus of integrals and primitives and mathematics taught in S1

Objectives:
Of primary importance for a scientist, this subject allows the student to acquire:

- methods for solving differential equations necessary for problems encountered in engineering and physics
- the methods of calculating differentiability and integrals of functions with several variables (surfaces, volumes), the different forms of limited expansion

Content of the material:

Chapter 1: Ordinary Differential Equations

1. Ordinary differential equations of the first order
1.1 Historical note.
1.2 Physical model leading to a differential equation.
1.3 General Definitions
1.4 General notions of differential equations of the first order.
□□General solution. Special solution.
1.5 Equations with separate and separable variables.
1.6 Homogeneous equations of the first order. Definitions and examples.
□□Solving the homogeneous equation.
1.7 Equations related to homogeneous equations.
□□Solving the linear equation.
1.8 Bernoulli's equation.
□□Definition. Solving Bernoulli's equation.
2. Second-order differential equations
2.1 Historical note.
2.2 Homogeneous linear equations. General definitions and properties.
2.3 Homogeneous second-order linear equations with constant coefficients
The roots of the characteristic equation are real and distinct.
The roots of the characteristic equation are complex.
The characteristic equation admits a double real root.
2.4 Homogeneous linear differential equations of order n with constant coefficients.
Definition. General solution. General method for calculating n linearly independent solutions of the homogeneous equation.
2.5 Non-homogeneous linear equations of the second order
Method of the variation of arbitrary constants.
2.6 Non-homogeneous second-order linear equations with constant coefficients
Cases where the second limb is of the form
a. The number is not a root of the characteristic equation:

b. is a simple root of the characteristic equation:
c. is a double root of the characteristic equation:
Cases where the second limb is of the form
a. if is not the root of the characteristic equation:
b. if is the root of the characteristic equation:

Chapter 2: Functions of several variables. Notions of limit, continuity, partial derivatives, differentiability

2.1 Historical note
2.2 Scope of Definition.
2.3 Concept of limit.
Introduction. Notion of neighbourhood. Defining the Limit of a Function of Two variables. Do not confuse limit following a direction with limit.
2.4 Continuity of the functions of two variables.
2.5 One-order partial derivatives.
Definition of partial derivatives of order one of a function of 2 variables at a point (x_0,y_0)
The partial derivative function. Partial derivatives of order two. Continuity and existence of partial derivatives $((\partial f)/(\partial x))$ and $((\partial f)/(\partial y))$
2.6 Differentiable functions.
Introduction. Definition of differentiable functions. Case of the functions of a real variable $f:R\rightarrow R$.
Definition of differentiable functions. Case of functions of two variables $f:R^2\rightarrow R$
Relation between differentiable function and existence of partial derivatives $((\partial f)/(\partial x))$ and $((\partial f)/(\partial y))$. Relationship between differentiability and continuity.
2.7 Notion of differential of a function of two variables.
2.8 Partial derivatives of compound functions.
Partial derivatives of compound functions of type 1. Derived from compound functions of type 2.
2.9 Taylor's formula for functions of 2 variables.
Partial derivatives of order n, $n>2$.
2.10 Differentiable optimization in R^2.
Definitions of local and global optimum. Necessary conditions of optimality. Sufficient conditions for optimality.

Chapter 3

1. Dual Integrals
1.1 Definition of the double integral
1.2 Examples
1.3 Properties of the double integral
- Linearity,
- Preservation of order,
- Additivity.

1.4 Fubini's theorem in the case of a bounded domain R .
1.5 Calculation of Double Integrals
- Direct calculation,
- Changing variables in a double integral (Variable change formula).

1.6 Applications: Center of Gravity, Moment of Inertia.
2. Triple Integrals
2.1 Generalization of the notion of double integrals to triple integrals.
2.2 Calculating a Triple Integral

- Direct calculation
- Calculation by change of variables (Formula for changing variables for a triple integral).
- Volume under the graph of a function of two variables.
- Calculation of the volume of certain solid bodies.

2.3 Applications: Center of Gravity, Moment of Inertia.

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

[1] Kada Allab, Eléments d'Analyse. Office des publications Universitaires. Ben Aknoun. Alger 1984

[2] N. Piskounov, Calcul différentiel et integral. Editions Mir. Moscou 1978

[3] J. Dixmier, Cours de mathématiques du premier cycle. 1ère année. Gauthiers-Villars. Paris 1976

[4] R. Murray Spiegel. Théorie et applications de l'Analyse. McGraw-Hill, Paris 1973

[5] G. Flory, Topologie, Analyse. Exercices avec solutions. Vuibert. Paris 1978

Semester: 2
Course Unit: UEF 1.2.2
Subject: Algebra 2
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Prerequisites:
- Algebra 1

Objectives:
- Consolidate the achievements of the 1st semester.
- Study new concepts: sum of several vector subspaces, stable subspaces, trace.
- Moving from the geometric register to the matrix register and vice versa.

Content of the course:

Chapter 1: Vector Spaces
- Definition (on $\mathbb{R}$ and.$\mathbb{C}$)
- Vector subspaces.
- Sum of subspaces.
- Additional subspaces.
- Free family. Linked family. Base (finished).

Chapter 2: Linear Applications
- Definition (operations).
- Core and image.
- The rank of a linear map.
- Rank theorem.
- Characterization of injection, surjection, and bijection.

Chapter 3: Matrices, Associated Matrices and Determinants
- Definition (as an array of numbers). Special matrices.
- Operations on matrices. The vector space of matrices.
- Determinants (definition (order 2, 3 and generalization) and properties).
- Invertible matrix.
- Matrix writing of a linear map.
- Correspondence between operations on linear maps and those on matrices.
- Base Change Matrix (Transition Matrix).
- The effect of a base change on the matrix of a linear map.

Chapter 4: Systems of Linear Equations
- Definitions and interpretations.

- Cramer's systems (general case).

Chapter 5: Matrix Reduction.

- Eigenvalues.
- Eigenvectors.
- Characteristic polynomials. Cayley-Hamilton theorem.
- Characterization of diagonalizable matrices.
- Characterization of trigonalizable matrices.
- Applications of reduction.

Bibliographical references:

- A.KUROSH : Cours d'algèbre supérieure. Edition MIR MOSCOU.
- D.FADEEV et I.SOMINSKY : Recueil d'exercices d'algèbre supérieure. Edition MIR MOSCOU.
- J.RIVAUD : Exercices avec solutions tome 1 VUIBERT.
- J.RIVAUD : Exercices avec solutions tome 2 VUIBERT.
- LEBSIR HABIB : Travaux dirigés d'algèbre générale. Dar el-houda Ain M'LILA.
- Jean-Pierre Escofier : Toute l'algèbre de la licence. Cours et exercices corrigés. Dunod.
- J.Lelong-Ferrand, J.M.Arnaudiès : Cours de mathématiques. Tome 1 Algèbre 3^{e}édition. Classes préparatoires 1ercycle universitaire. Dunod.
- A.DONEDDU : ALGEBRE ET GEOMETRIE 7 Mathématiques spéciales Premier cycle universitaire. VUIBERT.
- COLLET Valérie : MATHS Toute la deuxième année. ellipses

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Semester: 2
Course Unit: UEF 1.2.3
Material: Electricity and magnetism
VHS: 67.5 hours (Lecture: 1.5 hours – Tutorial 3 hours)
Credits: 6
Coefficient: 3

Prerequisites:

- Notions of vector field and scalar field.
- Notions of vector calculus.
- Electrical charges.

Objectives:

- Identify the sources of the electric and magnetic fields.
- Calculate and differentiate vector and scalar fields.
- Calculate the electrical field and potential produced by a load distribution.
- Calculate the magnetic field produced by an electric current.

Content of the material:

Chapter 1: Electrostatic field and potential
– Point charging.
– Electric force and Coulomb's law.
– Electric field and potential (discontinuous charge distribution).
– Electric dipole: electric field and potential.
– Action of the electric field on a dipole (orientation and state of equilibrium).
– Electrical field and potential (continuous charge distribution).
– Gauss's theorem.

Chapter 2: The Drivers
– Basic properties.
– Induced load and influencing phenomena
– Electrostatic pressure. – Capacitors, capacitance (various types), stored energy.

Chapter 3: Electric Current
– Notions of current intensity and density.
– Resistance and Ohm's Law, Joule's Law.

Chapter 4: Magnetostatic
– Introduction.
– Magnetic force and Lorentz's law.
– Action of a magnetic field on an electric current.
– Magnetic field produced by a standing current: Biot-Savart's law.
– Circulation of the magnetic field.
– Rotational magnetic field and Ampere's law.
– Magnetic field flux through a closed loop and induction.

– Maxwell's equations.

Bibliographical references:

- Physique, 2. Electricité et magnétisme, Harris Benson, éditions de Boeck.
- Physique, 2. Electricité et magnétisme, Eugene Hecht, éditions de Boeck.
- Physique Générale, Electricité et magnétisme, Douglas Giancoli, éditions de Boeck

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Semester: 2
Course Unit: UEF 1.2.4
Material: Thermodynamics
VHS: 67.5 hours (Lecture: 1.5 hours, TUTORIAL: 3 hours)
Credits: 6
Coefficient: 3

Objectives:
The knowledge acquired makes it possible to characterize the behavior of liquid, solid and gaseous substances and to evaluate their thermodynamic properties under different conditions (temperature, pressure, pure simple bodies, ideal mixture and phase change)

Material content

Chapter I: **Fundamentals of Thermodynamics**
I.1 Mathematical reminder on partial derivatives
I.2 Properties and states of a system
I.3 Process, equilibrium and thermodynamic cycle
I.4 Density, specific volume,
I.5 Pressure, Temperature and Energy
Chapter II: **Thermodynamic Properties of Pure Substances**
II.1 The ideal gas
II.2 Actual gas behaviour
II.3 Corresponding statements and residual differences
II.4 Properties of Liquids and Solids
Chapter III: **Fundamental Concepts of Thermodynamics**
II.1 First Principle and Applications
II.2 Entropy and the Second Law
II.3 Entropy Balance and Irreversibility
II.4 Properties of free energy and thermodynamic equilibrium
II.5 Chemical Potential and Fugacity
Chapter IV: **Equilibrium of Physical Processes**
IV.1 Phase equilibria of a pure substance
IV.2 Thermodynamic properties of phase transitions
IV.3 Ideal Behaviour of Gas, Liquid and Solid Mixtures
IV.4 Phase Equilibria of an Ideal Mixture Compound
IV.5 Ideal solubility and partition coefficient

Evaluation method:
Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

[1] Smith, E.B., Basic Chemical Thermodynamics, 2nd ed., Clarendon Press, Oxford, 1977.
[2] Rossini, F. D., Chemical Thermodynamics, Wiley, New York, 1950. Florence,
[3] Stanley I. Sandler, Chemical and Engineering Thermodynamics, Wiley, New York, 1977.
[4] Elliot,J, Lira C.T., Introductory chemical engineering Thermodynamics , Prentice –Hall (1999)
[5] Lewis G.N., Randal M., Thermodynamics, Mac Graw Hill
[6] Hougen O.A., Watson K.M., Chemical process principles, Vol II: thermodynamics John Wiley and sons

Semester: 2
Course Unit: UEM 1.2.1
Subject 1: Practical work Electricity and magnetism
VHS: 45 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives
Consolidate the theoretical notions covered in the Physics 2 course through practical work sessions.

Recommended Prior Knowledge
Mathematics 1, Physics 1.

Material content:

5 manipulations at least (3 hours / 15 days)

- Presentation of the instruments and measurement tools (Voltmeter, Ammeter, Rheostat, Oscilloscopes, Generator, etc.).
- Kirchhoff's laws (law of meshes, law of knots).
- Thévenin's theorem.
- Association and measurement of inductors and capacitances
- Charging and discharging a capacitor
- Oscilloscope
- Practical work on magnetism

Evaluation method:
Continuous Assessment: 100%

Semester: 2
Course Unit: UEM 1.2.2
Material: Thermodynamic practical work
VHS: 22.5 hours (PRACTICAL WORK: 3:00 am)
Credits: 2
Coefficient: 1

Prerequisites:

None

Objectives:

The knowledge acquired makes it possible to characterize the behavior of liquid, solid and gaseous substances and to evaluate their thermodynamic properties under different conditions (temperature, pressure, pure simple bodies, ideal mixture and phase change)

Practical work in Thermodynamics:

Lab N° 1: Study of the equation of state of an ideal gas.
Lab N° 2: Water value of the calorimeter.
Lab N° 3: Heat mass: heat density of liquid and solid bodies.
Practical work N° 4: Study of the solidification of pure water.
Lab N° 5: Latent heat: Latent heat of melting ice.
Lab N° 6: Determination of the latent heat of vaporization.
Lab N° 7: Heat of reaction: Determination of the energy released by a chemical reaction (HCl/NaOH).
Lab N° 8: The thermodynamic functions of an Acid–Base equilibrium.
Lab N° 9: Study of the variation of pressure as a function of the equilibrium temperature (l-g) for a pure system: water.
Lab N° 10: Vapour pressure of a solution.
Lab N°11: Equilibrium diagram for a binary system.
Lab N°12: Equilibrium diagram for a ternary system.

Evaluation method:

Continuous assessment: 100%;

Semester: 2
Course Unit: UEM 1.2.3
Subject 3: Introduction to programming
VHS: 45 hours (Lecture: 1.5 hours, PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 2

Teaching objectives

- Acquire the fundamental basics of programming
- Master the syntax and structures of the C language
- Understand basic algorithmic concepts
- Develop problem-solving skills through programming
- Implement functional programs in C
- Acquire best practices for programming and documenting code

Recommended Prior Knowledge

- No prior programming experience is required
- Basic Mathematics (Terminal Level)
- Basic computer skills
- Basic knowledge of an operating system

Content of the material:

Chapter 1: Introduction to Computer Science and Programming (1 Weeks)

- History of programming languages, Notion of algorithm and programming, The process of developing a programm Introduction to the development environment

Chapter 2: Structure of a C Program and Data Types (2 Weeks)

- Fundamental structure of a C program; Variables and constants; Primitive data types (int, float, double, char), Arithmetic and logical operations

Chapter 3 : Inputs/OuPractical Workuts and Expressions (2 Weeks)

- Using the printf() and scanf() functions, formatting datam Expressions and evaluation orderm Type conversions

Chapter 4 : Iterative Conditional Control and Control Structures (3 Weeks)

- if-elsem statements comparison operatorsm logical operatorsm switch-casem structure while and do-whilem loop form loop nesting loopsm break and continue statements

Chapter 5 : Functions and Arrays and Strings (3 Weeks)

- Defining and Declaring Functionsm Passing Parametersm Return Valuesm Recursive Functions, Declaring and Working with Arraysm Multidimensional Arraysm Strings in Cm Standard Functions for Strings

Chapter 6 :P Dentists and Dynamic Allocation (2 Weeks)

- Memory Address Concept & and *m Memory Allocation and Release Relationship Between Arrays and Pointers

Chapter 7 : Structures and Enumerations (2 Weeks)

- Defining structured typesm Accessing membersm Structure arraysm Enumerations

Detailed content of the practical sessions

Lab 1: Getting to grips with the environment

- Installing the IDE (Code::Blocks, Visual Studio Code with C extensions)
- First "Hello World" program
- Compilation and execution
- Simple error correction

Lab 2: Variables and expressions

- Declaring and initializing variables
- Arithmetic operators
- Simple calculations and display of results

Lab 3: Conditional Structures and Iterative Structures

- Implementing Programs with if-else
- Using switch-cases
- Comparison operators and logics
- Implementing while, do-while, and for loops
- Creation of meters and accumulators
- User input validation

PRACTICAL WORK 4 : Functions

- Creating and calling functions
- Passing parameters by value
- Organizing Code Functions

Lab 5: One-dimensional and multi-dimensional tables

- Manipulating Arrays
- Search and sort (simple algorithms)
- Switching from Arrays to Functions
- Creating and manipulating dies
- Matrix Operations

Lab 6: Strings

- Manipulating Strings with Functions in the string.h Library
- Word processing

Lab 7: Pointers and Dynamic Allocation

- Using pointers
- Memory allocation and release
- Dynamic Tables

PRACTICAL WORK 8: Files

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. Kernighan, B. W., & Ritchie, D. M. (2022). *Le langage C : Norme ANSI*, 2e édition. Dunod.
2. Perry, G. (2007). Exercices corrigés sur le Langage C, 2e édition . Dunod.
3. Delannoy, C. (2016). *Programmer en langage C : Cours et exercices corrigés*, 5eme édition. Eyrolles.
4. Tanenbaum, A. S. (2008). Systèmes d'exploitation Avec plus de 400 exercices, 3e édition. Pearson.
5. *Yves*, M. (2009). C en action Solutions et exemples pour les programmeurs en C, 2e édition, ENI, ISBN10 : 2746052563.
6. Ressourcesenligne :
    - *Learn C Programming* sur https://www.learn-c.org/
    - *C Programming* sur https://www.tutorialspoint.com/cprogramming/

Semester: 2
Course Unit: UET 1.2
Subject 1: Free and Open Source Software
VHS: 45 hours (Course: 1.5 hours & Workshop: 1.5 hours)
Credits: 2
Coefficient: 2

Teaching objectives:

This subject aims to familiarize students with the free and open source software ecosystem, its philosophical and technical foundations, and its practical application to replace proprietary solutions. At the end of this training, students will be able to:

- Understand the fundamental concepts of free and open source software
- Master the main free licenses and their legal implications
- Identify and use free alternatives to common proprietary software
- Install and configure free solutions adapted to the Algerian context
- Adopt an ethical and collaborative approach to software development

Content of the material:

Chapter 1: Foundations of Free Software (2 weeks)
- History of the Free and Open Source Software Movement
- Difference between "free software" and "open source"
- Richard Stallman's Philosophy and the GNU Project
- Economic and social impact of free software in Algeria and around the world

Chapter 2: Legal Framework and Licensing (2 weeks)
- Introduction to Software Copyright
- Main free licenses: GPL, LGPL, BSD, MIT, Apache
- License compatibility
- Implications for Algerian educational institutions and companies

Chapter 3: Free Operating Systems (3 weeks)
- Introduction to GNU/Linux
- Presentation of distributions adapted to the educational context
- Installation principles and basic configuration
- Fundamental Commands and Package Management

Chapter 4: Free Office Solutions (3 weeks)
- LibreOffice as an alternative to Microsoft Office
  - ✓ Writer (word processor)
  - ✓ Calc (spreadsheet)
  - ✓ Impress (presentation)
- Open Document Formats
- Migration of existing documents
- Configuration for the Algerian context (language, formats)

Chapter 5: Creative Solutions and Development (3 weeks)
- Graphics alternatives: GIMP, Inkscape
- Development tools: Free IDEs, Git
- Web tools: free browsers, open source CMS
- Free databases: MySQL/MariaDB, PostgreSQL

Chapter 6: Prospects and Future of Free Software (2 weeks)
- Open source communities and contribution methods
- Free Software Business Models
- Public policies and free software in Algeria

- Open Source Software Opportunities

Workshops

Atl. 1: Discovering Linux

- Installing a Linux distribution in a virtual machine
- Basic configuration and customization of the system
- Navigating the interface and using basic controls

Atl. 2: Software Management on Linux

- Using Package Managers
- Installing and updating software
- Configuring Software Repositories

Atl. 3: Migration to LibreOffice

- Installing and configuring LibreOffice
- Create and edit documents with Writer
- Conversion from proprietary to open formats
- Creation of models adapted to the needs of the student

Atl. 4: Spreadsheets and free presentations

- Advanced use of Calc (formulas, graphs)
- Creating presentations with Impress
- Compatibility with existing formats
- Collaborative work on documents

Atl. 5: Image processing and graphics

- Using GIMP for Image Editing
- Graphic design with Inkscape
- Comparison with corresponding proprietary tools
- Realization of a simple graphic project

Atl. 6: Web and free databases

- Installation and configuration of an open source CMS (WordPress, Joomla)
- Configuring a MariaDB Database
- Creating a simple website
- Basic security

Atl. 7: Collaborative Development

- Using Git for Version Control
- Setting up an open source development environment
- Participation in a mini-collaborative project
- Using a software forge (GitHub, GitLab)

Evaluation method: 100% exam

Bibliographical references:

1. Stallman, R. (2002). "Free as in Freedom : Richard Stallman's Crusade for Free Software", 1st Edition,O'Reilly Media.
2. Mathieu , N. (2012). "Reprenez le contrôle à l'aide de Linux - 2e édition". EYROLLES.
3. Stutz, M. (2001). "The Linux Cookbook: Tips and Techniques for Everyday". No StarchPress.
4. Collectif Eni. (2009). " Initiation aux logiciels libres OpenOffice.org 3, Firefox 3 et Thunderbird". ENI Editions.
5. François, E. (2009). "L'économie du logiciel libre". EYROLLES.
6. Marie, C. (2014). " Des logiciels libres pour le Maghreb ? Des opportunités théoriques aux réalités empiriques ". Institut de recherche sur le Maghreb contemporain.
1. Documentation du projet GNU: https://www.gnu.org/doc/doc.html
2. Stallman, R. M. (2002). *Free Software, Free Society: Selected Essays of Richard M. Stallman.*GNU Press.

Semester: 3
Course Unit: UEF 2.1.1
Material: Analysis 3
VHS: 67.5 hours (Lecture: 1.5 hours, TUTORIAL: 3 hours)
Credits: 6
Coefficient: 3

Prerequisites:
It is recommended to master the fundamental basics of calculus of integrals and primitives of multivariate functions and the mathematics taught in S1 and S2

Objectives:
Of primary importance for a scientist, this subject allows the student to acquire:

- The use of vector analysis dedicated to the description of several physical and practical phenomena
- mastery of the Fourier transform for the most common applications
- mastery of the Laplace transform for solving equations and systems of differential equations

Content of the material:

Chapter 1: Vector Analysis

1. Scalar fields and vector fields
Defining a Scalar Field
Defining a vector field
2. Circulation and gradient
Definition (Circulation of a vector field)
Definition (Gradient of a Scalar Field)
Definition (Gradient Fields)
3. Divergence and rotational
Definition (Divergence of a vector field)
Definition (Rotational of a vector field)
Definition (Rotational Fields)
Definition (Laplacian of a scalar field)
4. Scalar potentials and vector potentials
5. Curvilinear integral
6. Calculation of the curvilinear integral
7. Green's Formula
8. Conditions for a Curvilinear Integral Not to Depend on the Integration Path
9. Surface Integrals
10. Calculating Area Integrals
11. Stockes Formula
12. Ostrogradsky Formulas

Chapter 2: Numerical and integer series
I- Numerical series
1. General:

Partial sum. Convergence, divergence, sum and remainder of a converging series.
2. Necessary condition for convergence.
3. Properties of convergent numerical series
4. Numerical series with positive terms
4.1 Convergence criteria
Necessary and sufficient condition for convergence.
4.2 Criterion of comparison
Theorem
Consequence (Equivalence rule)
4.3 D'Alembert's rule
- Theorem
4.4 Cauchy's Rule
- Theorem
4.5 Cauchy integral criterion
- Theorem
5. Series with any term
5.1 Alternating Series.
Definition of an alternating series
Leibnitz's theorem (Alternating series theorem)
5.2 Absolutely convergent series
Definition of an absolutely convergent series
Theorem: CVA⇒CVS
5.3 Semi-convergent series.
Definition of a semi-convergent series
Examples
5.4 Abel's Test
Theorem (Abel's First Criterion for Series)

II- Whole series

1. Definition of an integer series,
Lemma of ABEL,
Radius of convergence
Determination of the radius of convergence,
HADAMARD's rule.
2. Properties of whole series.
Linearity and product of two whole series,
Normal convergence of an ES of a real variable under any segment included in the open convergence interval,
Continuity of the sum over the open convergence interval,
Term-by-term integration of an ES of a real variable on the convergence interval,
Term-to-term derivation of an S.E. of a real variable on the convergence interval.
3. Expansion in S.E.au neighborhood of zero of a function of a real variable.
Function expandable in S.E. on the open convergence interval.
Taylor-Maclaurin series of a function of class ∞
Uniqueness of development in SE
4. Applications.
Establish the integer series expansions of the usual functions
Finding a solution of an ordinary differential equation of the first and second order with variable coefficients in the form of S.E.

Chapter 3: Fourier series

1. General definitions
2. Fourier coefficients.
3. Function expandable into a Fourier series.
4. Dirichlet's theorem
5. Parseval's equality.
6. Application: simple examples of Sturm-Liouville problems.

Chapter 4: Fourier and Laplace transforms

1. The Fourier integral
2. Complex form of the Fourier integral.
3. Definitions and first properties

Definition of a Fourier transform and its inverse
Derived from the Fourier transform

Laplace transform

1- Definition of the Laplace transform
2 - Properties of the Laplace transform
(Uniqueness, Linearity, Scaling Factor, Derivation, Integration, Theorems)
3 - Common Laplace transforms
4 - Solving differential equations by Laplace transform

Evaluation methods:

Exam: 60% and CC: 40%

Bibliographical references:

1. Med El Amrani, Suites et séries numériques, Ellipses.
2. François Liret ; mathématiques en pratiques, cours et exercices; Dunod. (f.p.v ; Int. Mult. Séries…)
3. Marc Louis, Maths MP-MP, Ellipses. (Int. Doubles)
4. Denis Leger, PSI. Exercices corrigés Maths, Ellipses. (Séries de Fonctions, Entières, Fourier…)
5. Charles-Michel Marle, Philippe Pilibossian, Sylvie Guerre- Delabrière, Ellipse. (Suites, Séries, Intégrales).
6. Fabrice Lembiez Nathan, Tout en un, Exercices de maths.
7. Valerie Collet, Maths toute la deuxième année, 361 exercices, rappels de cours, trucs et astuces, ellipses.
8. A.Monsouri, M.K.Belbarki. Elément d'analyse. Cours et exercices résolus. 1er cycle universitaire. Chiheb. (Intégrales doubles et triples, Séries, Transformations de Fourier et de Laplace, Equations aux dérivées partielles du 2iéme ordre).
9. B.DEMIDOVITCH. Recueil d'exercices et de problèmes d'analyse mathématiques.11iéme édition. Ellipses. (Fonctions de plusieurs variables, Séries, Intégrales multiples)

Semester: 3
Course Unit: UEF 2.1.1
Matter 2: Waves and Vibrations
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives

To introduce the student to the phenomena of mechanical vibrations restricted to small amplitude oscillations for 1 or 2 degrees of freedom as well as to the study of the propagation of mechanical waves.

Recommended Prior Knowledge

Mathematics 2, Physics 1 and Physics 2

Content of the material:

***Preamble**: This subject is divided into two parts, the Waves part and the Vibrations part, which can be approached independently of each other. In this regard, and because of the consistency of this subject in terms of content, it is advisable to approach this subject in this order: Waves and then Vibrations for students in the Electrical Engineering courses (Group A). While for students in Groups B and C (Civil Engineering, Mechanical Engineering and Process Engineering), it is wise to start with Vibrations. In any case, the teacher is called upon to do his or her best to cover both parts. We remind you that this subject is intended for engineering professions in the Science and Technology Field. Also, the teacher is asked to go over all the parts of the course that require demonstrations or theoretical developments and to focus only on the application aspects. Moreover, the demonstrations can be the subject of auxiliary work to be asked of the students as activities within the framework of the student's personal work. On this subject, please refer to the paragraph "G- Evaluation of the student through continuous assessment and personal work" in this training offer.*

Part A: Vibration

Chapter 1: Introduction to Lagrange Equations **2 weeks**
1.1 Lagrange equations for a particle
1.1.1 Lagrange equations
1.1.2 The case of conservative systems
1.1.3 Velocity-dependent frictional forces
1.1.4 Case of an external time-dependent force
1.2 Multi-degree-of-freedom system.

Chapter 2: Free Oscillations of One-Degree-of-Freedom Systems **2 weeks**
2.1 Undamped Oscillations
2.2 Free Oscillations of Damped-Systems

Chapter 3: Forced Oscillations of Systems at a Degree of Freedom 1 week
3.1 Differential equation
3.2 Mass-spring-shock absorber system
3.3 Solution of the differential equation
3.3.1 Harmonic excitation
3.3.2 Periodic excitation
3.4 Mechanical Impedance

Chapter 4: Free Oscillations of Two-Degree-of-Freedom Systems **1 week**
4.1 Introduction
4.2 Two-degree-of-freedom systems

Chapter 5: Forced Oscillations of Two-Degrees-of-Freedom Systems 2 weeks
5.1 Lagrange equations
5.2 Mass-spring-shock absorber system
5.3 Impedance
5.4 Applications
5.5 Generalization to n-degree-of-freedom systems

Part B: Waves
Chapter 1: Phenomena of one-dimensional propagation 2 weeks
1.1 General and basic definitions
1.2 Propagation equation
1.3 Solution of the propagation equation
1.4 Sine Wave Traveling
1.5 Superposition of Two Sinusoidal Traveling Waves

Chapter 2: Vibrating Strings 2 weeks
2.1 Wave equation
2.2 Harmonic Traveling Waves
2.3 Free Oscillations of a Finite Length String
2.4 Reflection and transmission

Chapter 3: Acoustic waves in fluids 1 week
3.1 Wave equation
3.2 Speed of sound
3.3 Sine Wave Travelings
3.4 Reflection-Transmission

Chapter 4: Electromagnetic waves 2 weeks
4.1 Wave equation
4.2 Reflection-Transmission
4.3 Different Types of Electromagnetic Waves

Method of evaluation:
Continuous assessment: 40%; Final exam: 60%.

Bibliographical references:

1. H. Djelouah ; Vibrations et Ondes Mécaniques – Cours & Exercices (site de l'université de l'USTHB : perso.usthb.dz/~hdjelouah/Coursvom.html)
2. T. Becherrawy ; Vibrations, ondes et optique ; Hermes science Lavoisier, 2010
3. J. Brac ; Propagation d'ondes acoustiques et élastiques ; Hermès science Publ. Lavoisier, 2003.
4. R. Lefort ; Ondes et Vibrations ; Dunod, 2017
5. J. Bruneaux ; Vibrations, ondes ; Ellipses, 2008.
6. J.-P. Perez, R. Carles, R. Fleckinger ; Electromagnétisme Fondements et Applications, Ed. Dunod, 2011.
7. H. Djelouah ; Electromagnétisme ; Office des Publications Universitaires, 2011.

Semester: 3
Course Unit: UEF 2.1.2
Subject 1: Fundamental Electronics 1
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives:

Explain the calculation, analysis and interpretation of electronic circuits. To know the properties, electrical models and characteristics of electronic components: diodes, bipolar transistors and operational amplifiers.

Recommended Prior Knowledge

Notions of materials physics and fundamental electricity.

Content of the material:

The number of weeks displayed is given as an indication. It is obvious that the course leader is not required to strictly respect this sizing or the arrangement of the chapters.

Chapter 1. Continuous Regime and Fundamental Theorems 3 weeks

Definitions (dipole, branch, node, mesh), voltage and current generators (ideal, real), voltage-current relationships (R, L, C), voltage divider, current divider. Fundamental theorems: superposition, Thévenin, Norton, Millmann, Kennelly, Equivalence between Thévenin and Norton, Theorem of maximum power transfer.

Chapter 2. Passive quadrupoles 3 weeks

Representation of a passive network by a quadrupole. Quantities characterizing the behavior of a quadrupole in a setup (input and ouPractical Workut impedance, voltage and current gain), application to adaptation. Passive filters (low-pass, high-pass, ...), Gain curve, Phase curve, Crossover frequency, Bandwidth.

Chapter 3. Diodes 3 weeks

Basic reminders on the physics of semiconductors: Definition of a semiconductor, Crystal Si, Notions of doping, N and P semiconductors, PN junction, Constitution and operation of a diode, forward and reverse polarizations, Current-voltage characteristic, static and variable regime, Equivalent diagram. Applications of diodes: Single and double alternating rectifiance. Voltage stabilization by the Zener diode. Clipping, Other types of diodes: Varicap, LED, Photodiode.

Chapter 4. Bipolar transistors 3 weeks

Bipolar transistors: Transistor effect, operating modes (blocking, saturation, ...), Static characteristics network, Polarizations, Load line, Rest point, ... Study of the three fundamental assemblies: EC, BC, DC, Equivalent Scheme, Voltage Gain, Decibel Gain, Bandwidth, Current Gain, Input and OuPractical Workut Impedances. Study of LF multistage amplifiers in static and dynamic regimes, link capacitors, decoupling capacitors. Other uses of the transistor: Darlington assembly, switching transistor, ...

Chapter 5 - Operational amplifiers: 3 weeks

Principle, Equivalent Schematic, Ideal Op-Amp, Feedback, Op-Amp Features, Basic Op-Amp Setups: Inverter, Non-Inverter, Summer, Subtractor, Comparator, Follower, Diverter, Integrator, Logarithmic, Exponential, ...

Method of evaluation:

Continuous assessment: 40%; Final exam: 60%.

Bibliographical references:

1. A. Malvino, Principe d'Electronique, 6th Edition Dunod, 2002.
2. T. Floyd, Electronics Components and Application Systems, 5th Edition, Dunod, 2000.
3. F. Milsant, Cours d'électronique (et problèmes), Tomes 1 à 5, Eyrolles.
4. M. Kaufman, Electronics: The Components, Volume 1, McGraw-Hill, 1982.
5. P. Horowitz, Traité de l'électronique Analogue et Numérique, Tomes 1 et 2, Publitronic-Elektor, 1996.
6. M. Ouhrouche, Circuits électriques, Presses internationale Polytechnique, 2009.
7. Neffati, Electricité générale, Dunod, 2004
8. D. Dixneuf, Principes des circuits électriques, Dunod, 2007
9. Y. Hamada, Electronic Circuits, OPU, 1993.
10. I. Jelinski, Toute l'électronique en exercices, Vuibert, 2000.

Semester: 3
Course Unit: UEF 2.1.2
Subject 2: Fundamental Electrical Engineering 1
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives :

Know the basic principles of electrical engineering. Understand the working principle of transformers and electrical machines.

Recommended prior knowledge:

Notions of fundamental electricity.

Content of the material:

Chapter 1. Mathematical reminders on complex numbers (NC) (1Week)

Cartesian form, conjugated NCs, Modulus, Arithmetic operations on CNs (addition, ...), Geometric representation, Trigonometric form, Moivre's formula, root of CNs, Exponential representation of an NC, Trigonometric application of Euler's formulas, Application of CNs to electricity.

Chapter 2. Reminders of the fundamental laws of electricity (2 weeks)

Continuous regime: electric dipole, combination of R, C, L dipoles.
Harmonic regime: representation of sinusoidal quantities, mean and effective values, Fresnel representation, complex notation, impedances, powers in sinusoidal regime (instantaneous, active, apparent, reactive), Boucherot's theorem.
Transient: RL circuit, RC circuit, RLC circuit, capacitor charge and discharge.

Chapter 3. Electrical circuits and powers (3 weeks)

Single-phase circuits and electrical powers. Three-phase systems: Balanced and unbalanced (symmetrical components) and electrical powers.

Chapter 4. Magnetic circuits (3 weeks)

Magnetic circuits in sinusoidal alternating regime. Own and mutual inductors. Magnetic electrical analogy.

Chapter 5. Transformers (3 weeks)

Ideal single-phase transformer. Real single-phase transformer. Other transformers (isolated, impulse, autotransformer, three-phase transformers).

Chapter 6. Introduction to Electrical Machines (3 weeks)

General information on electrical machines. Working principle of generator and motor. Power balance and efficiency.

Method of evaluation :

Continuous assessment: 40%; Final exam: 60%.

Bibliographical references :

(Subject to the availability of documentation at the facility level, Websites... etc.)

1. J.P Perez, Electromagnétisme Fondements et Applications, 3eme Edition, 1997.
2. A. Fouillé, Electrotechnique à l'Usage des Ingénieurs, 10e édition, Dunod, 1980.
3. C. François, Génie électrique, Ellipses, 2004
4. L. Lasne, Electrotechnique, Dunod, 2008

5. J. Edminister, Théorie et applications des circuits électriques, McGraw Hill, 1972
6. D. Hong, Circuits et mesures électriques, Dunod, 2009
7. M. Kostenko, Machines Electriques - Tome 1, Tome 2, Editions MIR, Moscou, 1979.
8. M. Jufer, Electromécanique, Presses polytechniques et universitaires romandes- Lausanne, 2004.
9. A. Fitzgerald, Electric Machinery, McGraw-Hill Higher Education, 2003.
10. J. Lesenne, Introduction à l'électrotechnique approfondie. Technique et Documentation, 1981.
11. P. Maye, Moteurs électriques industriels, Dunod, 2005.
12. S. Nassar, Circuits électriques, Maxi Schaum.

Semester: 3
Course Unit: UEM2.1
Subject 1: Probability and statistics
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Objectives of the subject

This module allows students to see the essential notions of probability and statistics, namely: one- and two-variable statistical series, probability over a finite universe and random variables.

Recommended Prior Knowledge

Mathematics 1 and Mathematics 2

Material content:

Part A: Statistics

Chapter 1: Basic Definitions **(1 week)**

A.1.1 Concepts of population, sample, variables, modalities
A.1.2 Different types of statistical variables: qualitative, quantitative, discrete, continuous.

Chapter 2: Single-variable statistical series **(3 weeks)**

A.2.1 Staff, frequency, percentage.
A.2.2 Cumulative Staff, Cumulative Frequency.
A.2.3 Graphical representations: bar chart, pie chart, bar chart. Polygon of numbers (and frequencies). Histogram. Cumulative curves.
A.2.4 Position characteristics
A.2.5 Dispersion characteristics: range, variance and standard deviation, coefficient of variation.
A.2.6 Shape characteristics.

Chapter 3: Two-variate statistical series **(3 weeks)**

A.3.1 Data tables (contingency table). Point cloud.
A.3.2 Marginal and conditional distributions. Covariance.
A.3.3 Linear correlation coefficient. Regression line and Mayer line.
A.3.4 Regression curves, regression corridor and correlation ratio.
A.3.5 Functional adjustment.

Part B: Probability

Chapter 1: Combinatorial Analysis **(1 week)**

B.1.1 Arrangements
B.1.2 Combinations
B.1.3 Permutations.

Chapter 2: Introduction to Probability **(2 weeks)**

B.2.1 Algebra of events
B.2.2 Definitions
B.2.3 Probabilistic spaces
B.2.4 General probability theorems

Chapter 3: Conditioning and Independence **(1 week)**

B.3.1 Packaging,
B.3.2 Independence,
B.3.3 Bayes' formula.

Chapter 4: Random Variables **(1 week)**
B.4.1 Definitions and properties,
B.4.2 Dispatch function,
B.4.3 Mathematical Expectation,
B.4.4 Covariance and moments.

Chapter 5: Common Discrete and Continuous Probability Distributions (3 weeks)
Bernoulli, binomial, Poisson, ...; Uniform, normal, exponential, ...

Method of evaluation:
Continuous assessment: 40%; Final exam: 60%.

Bibliographical references:
1. D. Dacunha-Castelle and M. Duflo. Probabilités et statistiques : Problèmes à temps fixe. Masson, 1982.
2. J.-F. Delmas. Introduction au calcul des probabilités et à la statistique. Polycopié ENSTA, 2008.
3. W. Feller. an Introduction to Probability Theory and its Applications, Volume 1. Wiley & Sons, Inc., 3rd edition, 1968.
4. G. Grimmett, D. Stirzaker, Probability and Random Processes, Oxford University Press, 2nd edition, 1992.
5. J. Jacod and P. Protter, Probability Essentials, Springer, 2000.
6. A. Montfort. Cours de statistique mathématique. Economica, 1988.
7. A. Montfort. Introduction à la statistique. Ecole Polytechnique, 1991

Semester: 3
Course Unit: UEM2.1.2
Subject 2: Python Programming
VHS: 45 hours (TUTORIAL 1.5 hours, PRACTICAL WORK 1.5 hours)
Credits: 2
Coefficient: 2

Objectives of the material:

- Acquire the practical basics of programming with Python
- Develop algorithmic logic to solve simple problems
- Learn how to manipulate fundamental data structures
- Know how to write, test, and debug basic Python programs
- Apply programming concepts to practical cases

Recommended prior knowledge:

- No prior programming experience is required
- Basic knowledge of mathematics (high school level)
- Know how to use a computer (file browsing, text editor)

Content of the material:

Chapter 1. Install and use Python
Chapter 2. Basics
2-A. Interactive mode and script mode ,
2-A-1. Python Calculator,
*2-A-2. The use of operators: +, -, *, /, //, %, and **,*
2-A-3.c Priority
2-B. Variable and data type :
2-B-1. Variable Initialization, Variable Editing, Compound Assignment
2-B-2. Data Type:(. Number, Character, String)
2-B-3. Conversion (str function)
2-C. Preset Function
2-C-1. Use the functions of the math module (abs, max, min, pow, round, sin, sqrt, log, exp, acos, etc.)
2-C-2. Print function
2-C-3. Formatted ouPractical Workut (use the format function)
2-C-4. Input function
2-C-5. Function import
2-D. Source Code
2-D-1. Variable Naming Rule
2-D-2. Comment
Chapter 3. Conditional structures
(Minimal form in if, if-else form, full if-elif-else form)
The limits of the simple if condition
Comparison operators
Predicates and Booleans
The and, or and not keywords
Chapter 4. Loops
The while loop
The for loop

Interlocking loops
The keywords break and continue
Chapter 5. Functions
Creating Functions
Parameter defaults
Signing a Function
The return statement
The modules,
The import method
The import method: from ... import ...
Packages
Import packages
Create your own packages
Chapter 6: Lists and Tuples
Create and edit lists
Defining a List, Creating Lists
Insert objects into a list
Add an item to the end of the list
Insert an item in the list
Concatenation of lists
Removing items from a list
The keyword del
The remove method
The list journey
The function enumerates
Creating tuples
Chapter 7: Dictionaries
Creation and editing of dictionaries
Create a dictionary
Remove keys from a dictionary
Methods of the course
Key Journey
Values Journey
Toolpath of keys and values simultaneously
Dictionaries and function parameters
Chapter 8: Objects and Classes
Describe objects and classes, and use classes to model objects
Define classes with data fields and methods.
Construct an object using a constructor that invokes the initializer to create and initialize the data fields.
Chapter 9: Files
Relative and absolute paths
Reading and writing to a file
Opening the file
Close File
Read the entire file
Writing to a file
Write other types of data
The keyword with
Save objects to files
Save an object to a file

Evaluation method:
Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

[1] . Allen B. Downey Think Python: How to Think Like a Computer Scientist, O'Reilly Media, 2015;
[2] . Zed A. Shaw Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, Addison-Wesley Professional, 2017;
[3] . Barry, P. Head first Python: A brain-friendly guide. " O'Reilly Media, Inc.", 2016;
[4] . Ramalho, L.. Fluent Python. " O'Reilly Media, Inc.", 2022;
[5] . Swinnen, G.. Apprendre à programmer avec Python 3. Editions Eyrolles, 2012;
[6] . Le Goff, V.. Apprenez à programmer en Python. Editions Eyrolles, 2019;
[7] . Matthes, E. Python crash course: A hands-on, project-based introduction to programming. no starch press, 2019;

Practical work :

Lab 1 : Getting started with the Python environment (1 week)

1. Installing Python and a code editor (VS Code, PyCharm)
2. Getting Started with the Python Interpreter
    - Execute simple commands in interactive mode
    - Using Python as a Calculator
3. Creating and running a first Python script

Lab 2: Variables, Data Types and Operations (1 Week)

1. Manipulating fundamental data types
    - Integers, floats, strings, booleans
    - Converting between data types
2. Arithmetic operations and priorities

Lab 3: Conditional and Repetitive Structures (1 week)

1. Conditional statements (if, elif, else)
2. Loops (for, while)

Lab 4: Functions and modularity (1 week)

1. Defining and calling functions
2. Return parameters and values

Lab 5: Data Structures (1 week)

1. Manipulating lists
2. Dictionaries and tuples
3. Traversing and manipulating data structures

Lab 6: File Manipulation and Final Project (1 Week)

1. Reading and writing text files
2. Final project of your choice:
    - ✓ Command-line task manager
    - ✓ Hangman Game

- ✓ Analyzing data from a CSV file
- ✓ Interactive quiz with score saving

Method of evaluation:
Continuous assessment: 100%.

Bibliographical references :

1. Cyrille, H. (2018). Apprendre à programmer avec Python 3. Eyrolles, 6ème édition. ISBN: 978-2212675214
2. Daniel, I. (2024). Apprendre à coder en Python, J'ai lu
3. Nicolas, B. (2024). Python, du grand débutant à la programmation objet Cours et exercices corrigés, 3eme édition, Ellipses
4. Ludivine, C. (2024). Selenium Maîtrisez vos tests fonctionnels avec Python, Eni
5. Lutz, M. (2013). Learning Python, 5ème edition O′Reilly. ISBN: 978-1449355739

Online Resources

- Official Python documentation: docs.python.org
- Python exercises on Codecademy:codecademy.com/learn/learn-python-3
- W3Schools Python Tutorial:w3schools.com/python/

Semester: 3
Course Unit: UEM 2.1
Subject 3: Practical work in Electronics and Electrical Engineering
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

Consolidation of the knowledge acquired in the fundamental subjects of electronics and electrical engineering to better understand and assimilate the fundamental laws of electronics and electrical engineering.

Recommended Prior Knowledge

Fundamental electronics. Fundamental electrical engineering.

Content of the material:

The practical work teacher is called upon to complete at least 3 practical exercises in Electronics and 3 practical exercises in Electrical Engineering from the list of practical exercises proposed below:

Electronics Lab 1
Lab 1: Fundamental theorems
PRACTICAL WORK 2: Characteristics of passive filters
Lab 3: Characteristics of the diode / rectifier
PRACTICAL WORK 4: Stabilized power supply with Zener diode
Lab 5: Characteristics of a transistor and operating point
PRACTICAL WORK 6: Operational amplifiers.

Electrical Engineering Practical Work 1
Lab 1: Measurement of voltages and currents in single-phase
PRACTICAL WORK 2 : Measurement of voltages and currents in three phase
PRACTICAL WORK 3: Measurement of active and reactive power in three phases
Lab 4: Magnetic circuits (hysteresis cycle)
PRACTICAL WORK 5: Transformer Testing
PRACTICAL WORK 6: Electrical machines (demonstration).

Method of evaluation:

Continuous assessment: 100%

Bibliographical references:

Semester: 3
Course Unit: UEM 2.1
Subject 4: Waves and Vibrations
VHS: 15:00 (PRACTICAL WORK: 1 hour)
Credits: 1
Coefficient: 1

Teaching objectives

The objectives assigned by this program are to introduce students to put into practice the knowledge received on the phenomena of mechanical vibrations restricted to small amplitude oscillations for one or two degrees of freedom as well as the propagation of mechanical waves.

Recommended Prior Knowledge

Vibrations and waves, Mathematics 2, Physics 1, Physics 2.

Content of the material:

PRACTICAL WORK1 : Mass – spring
PRACTICAL WORK2 : Single clock
PRACTICAL WORK3 : Torsion pendulum
PRACTICAL WORK4 : Electrical circuit oscillating in free and forced regime
PRACTICAL WORK5 : Coupled Pendulums
PRACTICAL WORK6: Transverse Oscillations in Vibrating Wires
PRACTICAL WORK7: Grooved pulley according to Hoffmann
PRACTICAL WORK8: Electromechanical Systems (The Electrodynamic Loudspeaker)
PRACTICAL WORK9: Pohl's pendulum
PRACTICAL WORK10: Propagation of longitudinal waves in a fluid.

Note: It is recommended to choose at least 5 practical exercises among the 10 proposed.

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references:

Semester: 3
Course Unit: UED 2.1
Subject 1: State of the art of electrical engineering
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives
To give the student a general overview of the different existing courses in Electrical Engineering while highlighting the impact of electricity in improving the daily life of man.

Recommended Prior Knowledge
None

Content of the material:

1- The Electrical Engineering family: Electronics, Electrical Engineering, Automation, Telecommunications, etc. etc.

2- Impact of Electrical Engineering on the development of society: Advances in Microelectronics, Automation and Supervision, Robotics, Telecommunications Development, Instrumentation in the development of health, ...

Assessment method: Final exam: 100%.

Bibliographical references:
(Subject to the availability of documentation at the facility level, Websites... etc.)

Semester: 3
Course Unit: UED 2.1
Subject 2: Energy and environment
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

To make the student aware of the different existing energies, their sources and the impact of their uses on the environment.

Recommended prior knowledge:

Notions of energy and environment.

Content of the material:

Chapter 1: The Different Energy Resources

Chapter 2: Energy Storage

Chapter 3: Consumption, reserves and trends in energy resources

Chapter 4: The different types of pollution

Chapter 5: Detection and treatment of pollutants and wastes

Chapter 6: Impact of pollution on health and the environment.

Method of evaluation:

Final exam: 100%.

Bibliographical references :

1- Jenkins et coll., Electrotechnique des énergies renouvelables et de la cogénération, Dunod, 2008
2- Pinard, Les énergies renouvelables pour la production d'électricité, Dunod, 2009
3- Crastan, Centrales électriques et production alternative d'électricité, Lavoisier, 2009
4- Labouret et Villoz, Energie solaire photovoltaïque, 4e éd., Dunod,2009-10.

Semester: 4
Course Unit: UEF 2.2.1
Subject 1: Linear Continuous-Time Control Systems
VHS: 67.5 hours (Lecture: 3 hours, TUTORIAL: 1.5 hours)
Credits: 6
Coefficient: 3

Teaching objectives:

This course will allow the student to acquire knowledge on the control theory of continuous linear systems as well as on representation and analysis methods. By the end of the course, students will be able to model, analyze, and design simple controllers for automated systems.

Recommended Prior Knowledge

- Basic mathematics (Algebra, analysis, especially the manipulation of complex values, etc.)
- Basic notions of basic electronics (linear circuits) and physics.

Content of the material:

Chapter 1: General information on servo systems (2 weeks)

Overview of the history of control systems, Terminology of servo systems (disturbance, sePractical Workoint, control, ouPractical Workut, measurement noise, deviation, tracking, regulation, corrector, etc.), Automatic functions (monitoring/safety, control/regulation), Open-loop/closed-loop control, Structure and components of a control system.

Chapter 2: Laplace Transforms and Representation of Servo Systems (3 weeks)

Laplace transform of usual functions (definitions, properties, initial and final value theorem, ...), Inverse Laplace transform (definitions, properties, ...), Mathematical model of a system, Representation by differential equations, Representation of systems servoed by transfer functions (definition of static gain, poles, zeros of a transfer function), Block diagrams and simplification rules: series systems, parallel, unitary and non-unitary return, ...

Chapter 3: Time-domain analysis (2 weeks)

Transient regime, steady state and notions of stability, speed and static precision, Notion of impulse response, Response of first and second order systems for typical signals, Case of higher order systems, Identification of first and second order systems from the temporal response.

Chapter 4: Frequency domain systems analysis (4 weeks)

Introduction, Graphical representation of transfer functions (Bode diagrams, Nyquist place, Black-Nichols charts), Analysis and stability criteria (Bode/Nyquist plane reverse criterion, Nyquist criterion, Evans place, Routh criterion)

Chapter 5: Systems Synthesis (4 weeks)

Introduction, Synthesis specifications (stability, speed, accuracy), Different regulator structures (phase advance/delay, PID, RST), Choice of regulator according to the imposed specifications, Sizing of regulators:Synthesis by empirical methods (Ziegler-Nichols, Flat, symmetrical, ...), Synthesis by graphical methods (Evans, Bode, Black, Nyquist, ...).

Method of evaluation:
Continuous assessment: 40%; Final exam: 60%.

Bibliographical references:
1- Y. Granjon, Automatique - systèmes linéaires et continuous, Dunod 2003.
2- S. Le Ballois and P. Cordon, Automatique - systèmes linéaires et continus, Dunod 2006.
3- K. Ogata, Modern Control Engineering, Prentice Hall, 2010.
4- B. Kuo et al., Automatic Control Systems, John Wiley and Sons, 2008.

Semester: 4
Course Unit: UEF 2.2.1
Subject 2: Combinatorial and Sequential Logic
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives:

Know the usual combinatorial circuits. To know how to design some applications of combinatorial circuits using standard tools such as truth tables and Karnaugh tables. Introduce sequential circuits through toggle circuits, counters and registers.

Recommended Prior Knowledge

None.

Content of the material:

The number of weeks displayed is given as an indication. It is obvious that the course leader is not required to strictly respect this sizing or the arrangement of the chapters.

Chapter 1: Boolean Algebra and Simplification of Logical Functions 2 weeks

Variables and logical functions (OR, AND, NOR, NAND, XOR). Laws of Boolean algebra. De Morgan's theorem. Complete and incomplete logic functions. Representation of logical functions: truth tables, Karnaugh tables. Simplification of logical functions: Algebraic method, Karnaugh method.

Chapter 2: Numeral Systems and Information Coding 2 weeks

Representation of a number by codes (binary, hexadecimal, DCB, signed and unsigned binary, ...) base change or conversion, unweighted codes (Gray's code, error detector and corrector codes, ascii code, ...), arithmetic operations in binary code.

Chapter 3: Transcoder Combinatorial Circuits 2 weeks

Definitions, Decoders, Priority Encoders, Transcoders, Cascading, Applications, Analysis of the Datasheet of a Decoder Integrated Circuit, List of Decoding Integrated Circuits.

Chapter 4: Combinatorial Switchgear Circuits 2 weeks

Definitions, Multiplexers, Demultiplexers, Cascading, Applications, Switch IC Datasheet Analysis, IC List.

Chapter 5: Combinatorial Comparison Circuits 2 weeks

Definitions, 1-bit, 2-bit, and 4-bit comparison circuit, Cascading, Applications, Analysis of the datasheet of a comparison integrated circuit, List of integrated circuits.

Chapter 6: The Seesaws 2 weeks

Introduction to sequential circuits. The RS scale, The RST scale, The D scale, The Master-slave scale, The T scale, The JK scale. Examples of applications with toggles: Frequency divider by n, Pulse train generator, ...
It is advisable to present for each switch the truth table, examples of chronograms as well as the limits and imperfections.

Chapter 7: Meters 2 weeks

Definition, Classification of counters (synchronous, regular, irregular, asynchronous, full and incomplete cycles). Realization of complete and incomplete synchronous binary counters, Excitation tables of JK, D and RS toggles, Realization of modulo (n) asynchronous binary counters: complete, incomplete, regular and irregular. Programmable counters (start from any state).

Chapter 8. The Registers **1 week**

Introduction, classic registers, offset registers, loading and retrieving data in a register (PIPO, PISO, SIPO, SISO), offsetting data in a register, a universal register, the 74LS194A, available integrated circuits, Applications: classic registers, special counters, queues.

Method of evaluation:

Continuous assessment: 40%; Final exam: 60%.

Bibliographical references:

1- J. Letocha, Introduction aux circuits logiques, Edition McGraw Hill.
2- J.C. Lafont, Cours et problèmes d'électronique numérique, 124 exercices avec solutions, Ellipses.
3- R. Delsol, Electronique numérique, Tomes 1 et 2, Edition Berti
4- P. Cabanis, Electronique digitale, Edition Dunod.
5- M. Gindre, Logique combinatoire, Edition Ediscience.
6- H. Curry, Combinatory Logic II. North-Holland, 1972
7- R. Katz, Contemporary Logic Design, 2nd ed. Prentice Hall, 2005.
8- M. Gindre, Electronique numérique : logique combinatoire et technologie, McGraw Hill, 1987
9- C. Brie, Logique combinatoire et séquentielle, Ellipses, 2002.
10- J-P. Ginisti, La logique combinatoire, Paris, PUF (coll. « Que sais-je? » n°3205), 1997.
11- J-L. Krivine, Lambda-calcul, types et modèles, Masson, 1990, chap. Logique combinatoire, traduction anglaise accessible sur le site de l'auteur.

Semester: 4
Course Unit: UEF 2.2.2
Subject 1: Architecture of Automated Systems
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives

Introduce students to Industrial Automated Systems (AS) and their Architecture. To know the constituent bodies of the SA and their operating principles. This program is an introduction to different subjects of semesters five and six where they will be detailed.

Recommended prior knowledge:

Content of the material:

Chapter 1: Introduction **(2 weeks)**

Global approach to a production system, Objectives of production automation, Profitability of automation, Example of application.

Chapter 2: Structure of a Production System **(3 weeks)**

Decomposition of the OPERATIVE PART and the CONTROL PART (PO – PC), Elements of the P.O. and the P.C., Effector, Actuator (electric motor, pneumatic cylinder, ...), Pre-Actuator (contactors, relays, pneumatic distributors), Sensor (TOR sensors, analog sensors, transmitters), Processing (PLC, industrial PC...), Dialogue (HMI, SCADA...).

Chapter 3: Ordering part (**2 weeks**)

PC Type, Architecture, Programming

Chapter 4: Production Systems Architecture **(3 weeks)**

Stand-alone machines, Associated machines in line, Centrally controlled production cell, Decentralized and coordinated control cell, Flexible cell with distributed and hierarchical control.

Chapter 5: Notions of networks **(2 weeks)**

Industrial local area networks, Computer networks.

Chapter 6: Presentation and Case Study **(3 weeks)**

Electrical distribution, Petrochemical Process Control, Thermal, furnaces, ...

Note:

Favor an animated presentation using slides and videos,
Plan and organize a visit to the industrial site, if possible.

Assessment method: Final exam: 100%.

Bibliographical references:

1- Architectures de pilotage de procédés industriels Technique de l'ingénieur AG3510
2- Automatisme et procédés industriels agroalimentaires Technique de l'ingénieur F1290
3- Automates programmables industriels Technique de l'ingénieur S8015
4- Jean-Pierre THOMESSE, Réseaux locaux industriels - Concepts, typologie, caractéristiques Technique del'ingénieurRéf.S7574v1

Semester: 4
Course Unit: UEF 2.2.2
Subject 2: Signal Theory
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives:

Acquire the basic notions of the mathematical tools used in signal processing.

Recommended prior knowledge:

Basic mathematics course.

Content of the material:

Chapter 1. General information about signals (3 weeks)

Objectives of signal processing. Areas of use. Signal classification (morphological, spectral, ... etc.). Deterministic signals (periodic and non-periodic) and random signals (stationary and non-stationary). Causality. Notions of power and energy. Basic functions in signal processing (measurement, filtering, smoothing, modulation, detection, etc.) etc.). Examples of basic signals (rectangular, triangular, ramp, rung, sign, Dirac ... etc.)

Chapter 2. Fourier analysis (4 weeks)

Introduction, Mathematical reminders (dot product, Euclidean distance, linear combination, orthogonal basis, etc.) etc.). Approximation of signals by a linear combination of orthogonal functions. Fourier series, Fourier transform, Properties. Parseval's theorem. Fourier spectrum of periodic (discrete spectrum) and non-periodic (continuous spectrum) signals.

Chapter 3. Laplace transform (3 weeks)

Definition. Properties of the Laplace Transform. Signal/system relationship. Application to linear and translational invariant systems or SLIT (Temporal and Frequency Analysis).

Chapter 4. Convolution Product (2 weeks)

Convolution Product Formulation, Convolution Product Properties, Convolution Product and Dirac Pulse.

Chapter 5. Signal correlation (3 weeks)

Finite total energy signals. Signals with finite total average power. Intercorrelation between signals, Autocorrelation, Properties of the correlation function. Energy spectral density and power spectral density. Wiener–Khintchine theorem. Case of periodic signals.

Method of evaluation:

Continuous assessment: 40%; Final exam: 60%.

Bibliographical references:

1. S. Haykin, "Signals and systems", John Wiley & Sons, 2nd ed., 2003.
2. A.V. Oppenheim, "Signals and systems", Prentice-Hall, 2004.
3. F. de Coulon, "Théorie et traitement des signaux", Edition PPUR.
4. F. Cottet, "Traitement des signaux et acquisition de données, Cours et exercices résolus", Dunod.
5. B. Picinbono, "Théorie des signaux et des systèmes avec problèmes résolus", Edition Bordas.
6. M. Benidir, "Théorie et Traitement du signal, tome 1 : Représentation des signaux et des systèmes - Cours et exercices corrigés'', Dunod, 2004.
7. M. Benidir, "Théorie et Traitement du signal, tome 2 : Méthodes de base pour l'analyse et le traitement du signal - Cours et exercices corrigés'', Dunod, 2004.
8. J. Max, Traitement du signal

Semester: 4
Course Unit: UEM 2.2.2
Subject 1: Numerical methods
VHS: 67.5 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours, PRACTICAL WORK: 1.5 hours)
Credits: 5
Coefficient: 3

Teaching objectives:

Familiarization with numerical methods and their applications in the field of mathematical calculations.

Recommended prior knowledge:

Mathematics 1, Mathematics 2, Computer Science1 and Computer Science 2.

Content of the material:

Chapter 1.Solving the nonlinear equations f(x)=0 (3 weeks)
1. Introduction to calculation errors and approximations, 2. Introduction to methods for solving nonlinear equations, 3. Method of bisection, 4. Method of successive approximations (fixed point), 5. Newton-Raphson method.

Chapter 2.Polynomial interpolation (2 weeks)
1. General Introduction, 2. Lagrange polynomial, 3. Newton's polynomials.

Chapter 3. Function approximation: (2 weeks)
1. Approximation method and root mean square. 2. Orthogonal or pseudo-orthogonal systems. Approximation by orthogonal polynomials, 3. Trigonometric approximation.

Chapter 4.Digital integration (2 weeks)
1. General Introduction, 2. Trapeze method, 3. Simpson's Method, 4. Quadrature formulas.

Chapter 5.Solving ordinary differential equations
(Problem of the initial condition or Cauchy) (2 weeks)
1. General Introduction, 2. Euler's method, 3. Improved Euler method, 4. Runge-Kutta method.

Chapter 6.Method for the direct solution of systems of linear equations (2 weeks)
1. Introduction and definitions, 2. Gauss's method and pivoting, 3. LU Factorization Method, 4. Choeleski's factorization methodMM^t, 5. Thomas algorithm (TUTORIALMA) for tri-diagonal systems.

Chapter 7.Approximate method of solving systems of linear equations
(2 weeks)
1. Introduction and definitions, 2. Jacobi's method, 3. Gauss-Seidel method, 4. Use of relaxation.

Method of evaluation:

Continuous assessment: 40% (20% TUTORIAL+20% PRACTICAL WORK); Final exam: 60%.

Practical work Numerical methods

Teaching objectives:

Programming of the various numerical methods with a view to their applications in the field of mathematical calculations using a scientific programming language (Matlab, Scilab, ...).

Recommended Prior Knowledge

Numerical method, Computer Science 2 and Computer Science 3.

Content of the material:

Chapter 1: Solving nonlinear equations **3 weeks**

1. Method of bisection. 2. Fixed-point method, 3. Newton-Raphson method

Chapter 2: Interpolation and approximation **3 weeks**

1. Newton's interpolation, 2. Chebyshev's approximation

Chapter 3: Digital integrations **3 weeks**

1. Rectangle Method, 2. Trapezoid method, 3. Simpson's Method

Chapter 4: Differential equations **2 weeks**

1. Euler's method, 2. Runge-Kutta methods

Chapter 5: Systems of linear equations **4 weeks**

1. Gauss-Jordon's method, 2. Crout decomposition and factorization LU, 3. Jacobi's method, 4. Gauss-Seidel method

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references:

1. José Ouin, Algorithmique et calcul numérique : Travaux pratiques résolus et programmation avec les logiciels Scilab et Python, Ellipses, 2013.
2. Bouchaib Radi, Abdelkhalak El Hami, Mathématiques avec Scilab : guide de calcul programmation représentations graphiques ; conforme au nouveau programme MPSI, Ellipses, 2015.
3. Jean-Philippe Grivet, Méthodes numériques appliquées : pour le scientifique et l'ingénieur , EDP sciences, 2009.
4. C. Brezinski, Introduction à la pratique du calcul numérique, Dunod, Paris 1988.
5. G. Allaire et S.M. Kaber, Algèbre linéaire numérique, Ellipses, 2002.
6. G. Allaire et S.M. Kaber, Introduction à Scilab. Exercices pratiques corrigés d'algèbre linéaire, Ellipses, 2002.
7. G. Christol, A. Cot et C.-M. Marle, Calcul différentiel, Ellipses, 1996.
8. M. Crouzeix et A.-L. Mignot, Analyse numérique des équations différentielles, Masson, 1983.
9. S. Delabrière et M. Postel, Méthodes d'approximation. Équations différentielles. Applications Scilab, Ellipses, 2004.
10. J.-P. Demailly, Analyse numérique et équations différentielles. Presses Universitaires de Grenoble, 1996.
11. E. Hairer, S. P. Norsett et G. Wanner, Solving Ordinary Differential Equations, Springer, 1993.
12. P. G. Ciarlet, Introduction à l'analyse numérique matricielle et à l'optimisation, Masson, Paris, 1982.

Semester: 4
Course Unit: UEM 2.2
Subject 1: Electrical and electronic measurements
VHS: 45 hours (Lecture: 1.5 hours, PRACTICAL WORK: 1.5 hours)
Credits: 3
Coefficient: 2

Teaching objectives:

Introduce the student to the techniques of measuring electrical and electronic quantities. Familiarize him with the use of analog and digital measuring devices.

Recommended Prior Knowledge

General Electricity, Fundamental Laws of Physics.

Content of the material:

The number of weeks displayed is given as an indication. It is obvious that the course leader is not required to strictly respect this sizing or the arrangement of the chapters.

Chapter 1. Measurements, quantities, and uncertainties 5 weeks

Introduction, Quantity, Standard, Systems of units, Table of multiples and submultiples, Equations with dimensions, Useful formulas, Measurement accuracy, Measurement error, Classification of errors, Uncertainties in indirect measurements, Qualities of measuring apparatus, Calibration of measuring apparatus, Graphic symbols of measuring apparatus, General methods of measurement (Deviation, zero, resonance methods), Application exercises.

Chapter 2. Measurement methods 6 weeks

1. Voltage measurements: Direct methods of voltage measurements, Alternating voltage measurements, Indirect method of voltage measurements by the opposition method.
2. Current measurement: Direct method of measuring currents, Using simple shunt.
3. Resistance measurements: Classification of resistances, Volt-ampere method, Zero method: Wheatstone Bridge, Measurement of very large resistances by the pressure drop method.
4. Impedance measurements: Capacitance measurements, Inductance measurements, AC bridges.
5. Continuous Power Measurements: Fundamental Relationship, Ammeter and Voltmeter Method, Continuous Electrodynamic Power Meter.
6. Alternating Power Measurements: Instantaneous and Average Power, Complex Power, Apparent Power, Active Power and Reactive Power, Electrodynamic Alternating Power Meter, 3-Voltmeter Method for Active Power, Direct Reactive Power Measurement Method, Indirect Reactive Power Measurement Method
7. Phase shift measurements: Direct measurement of phase shifts with the oscilloscope, Measurement of phase shifts with Lissajous figures.
8. Frequency and period measurements: Direct frequency measurement with an oscilloscope, Frequency measurement with Lissajous figures, Frequency measurement by the frequency meter method, Frequency measurement by the period meter method, Application exercises.

Chapter 3. Measuring devices 4 weeks

Introduction
Analogue measuring devices: Classification of deviation devices, The moving frame galvanometer, Structure of the magnetoelectric ammeter, Structure of the magnetoelectric voltmeter, Operation of the electrodynamic power meter in alternating
Digital measuring devices: Analog-to-digital converters (ADCs), Principle of operation of a digital measuring device, Examples of digital measuring devices (Multimeter, Oscilloscope, etc.).
Practical work Electrical and electronic measurements:

Lab N° 1: Resistance measurement:

Perform the measurement of resistances by the following 5 methods: volt-ampere, ohmmeter, Wheatstone bridge, comparison and substitution.
Compare these methods with each other and calculate errors.

Lab N° 2: Inductance measurement:

Measure inductances using the following 3 methods: volt-amperetry, Maxwell bridge, resonance.
Compare these methods with each other and calculate errors.

Lab N° 3: Capacity measurement:

Measure capacitances using the following 3 methods: volt-amperetry, Sauty bridge, resonance.
Compare these methods with each other and calculate errors.

Lab N° 4: Phase shift measurement:

Perform the resistance measurement by the following 2 methods: Phase meter and oscilloscope.

PRACTICAL WORK N° 5: Single-phase power measurement:

Perform the measurement of resistances by the following 5 methods: power meter, Cosφmeter, three voltmeters, three ammeters, power meter.
Compare these methods with each other and calculate errors.

Lab N° 6: Three-phase power measurement:

Measure resistances by the following methods: Star system and triangle system, balanced and unbalanced.

Method of evaluation:

Continuous assessment: 40%; Final exam: 60%.

Bibliographical references:

1- M. Cerr, Instrumentation industrielle : T.1, Edition Tec et Doc.
2- M. Cerr, Instrumentation industrielle : T.2, Edition Tec et Doc.
3- P. Oguic, Mesures et PC, Edition ETSF.
4- D. Hong, Circuits et mesures électriques, Dunod, 2009.
5- W. Bolton, Electrical and Electronic Measurement and Testing, 1992.
6- A. Fabre, Mesures électriques et électroniques, OPU, 1996.
7- G. Asch, Les capteurs en instrumentation industrielle, édition Dunod, 2010.
8- L. Thompson, Electrical Measurements and Calibration: Fundamentals and Applications, Instrument Society of America, 1994.
9- J. P. Bentley, Principles of Measurement Systems, Pearson Education, 2005.
10- J. Niard, Mesures électriques, Nathan, 1981.
11- P. Beauvilain, Mesures Electriques et Electroniques.
12- M. Abati, Mesures électroniques appliquées, Collection Techniques et Normalisation Delagrave.
13- P. Jacobs, Mesures électriques, Edition Dunod.
14- A. Leconte, Mesures en électrotechnique (Document D 1 501), Les techniques de l'ingénieur.

Internet sources :

- http://sitelec.free.fr/cours2htm
- http://perso.orange.fr/xcotton/electron/coursetdocs.ht
- http://eunomie.u-bourgogne.fr/elearning/physique.html
- http://www.technique-ingenieur.fr/dossier/appareilsdemesure

Semester: 4
Course Unit: UEM 2.2
Subject 2: Linear Continuous-Time Control Systems
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives

To introduce students to apply the knowledge acquired on the theory of control systems. Teach the student how to use the tools to model, analyze, and design simple controllers for automated systems.

Recommended prior knowledge:

Linear Continuous-Time Control Systems. Fundamentals of electronics and physics

Content of the material:

The practical work can be organized in three parts: modeling/simulation, analysis and synthesis. The content of this module and the number of practical exercises to be carried out can be adjusted according to the equipment available in the laboratory. Simulations can be used to reinforce practical tests or to fill in the equipment gap.

Part 01: PC simulation lab (theoretical part)

Lab N°1: Solving differential equations representing the dynamics of systems (electrical, mechanical and electromechanical) using the Matlab software

Use of Matlab software commands such as: *ode45*, *ode123*, *Order4 Rank-Kutta*, ... etc.

Lab N°2: Determining the transfer function of a system and plotting temporal and frequency responses

Use of the commands*: Ident, Step, Impulse, Lsim, Ltiview, Bode, Nyquist,...*etc*.*

Lab 3: Improving the Performance of a Looped System - Introduction to Simulink Software

Define Simulink tools such as: *scope*, *source*, *comparator*, *step*, *pure delay*, *transfer function*, *perturbation*, *measurement noise*,... etc.

Use the *RLTOOL* command to synthesize the controller that stabilizes the transfer function.

Improve the performance of the looped system by adding poles and zeros to the corrector provided by the RLTOOL command.

Part 02: Practical validation

Lab N°1: Modeling and identification of an R-L-C electrical circuit by a first/second order model (random excitation by a voltage generator and measurement of the ouPractical Workut voltage by a voltmeter). The same goes for the two temperature sensors NTC and PT100.

Lab N°2: Study of a PID corrector made using operational amplifiers.

Lab N°3: Temperature regulation by an ALL or NOTHING.

Lab N°4: Adjustment of a first-rate system by a P and PI regulator.

PRACTICAL WORK N°5: Adjustment of a second-order system by a P, PI and PID regulator.

Lab N°6: Adjusting the speed of a DC motor.

Method of evaluation:
Continuous assessment: 100%.

Bibliographical references:
1-S. Le Ballois, P. Codron**,** Automatique : Systèmes linéaires et continus, Dunod 2006.
2- P. Prouvost, Automatique - Contrôle et régulation Cours, exercices et problèmes corrigés, Dunod 2010.
3- E. Godoy, Régulation industrielle Outils de modélisation, méthodes et architectures de commande, Dunod.

Semester: 4
Course Unit: UEM 2.2
Subject 3: Practical work Combinatorial and sequential logic
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

Consolidate the knowledge acquired during the course of the subject "Combinatorial and Sequential Logic" through practical work to better understand and assimilate the content of this subject.

Recommended Prior Knowledge

Combinatorial and Sequential Logic.

Content of the material:

The teacher chooses from this list of practical exercises between 4 and 6 practical exercises to be carried out and dealing with the two types of logic circuits (combinatorial and sequential).

PRACTICAL WORK1: TTL and CMOS integrated circuit technology.
Understand and test the different logic gates

PRACTICAL WORK2: Simplification of logical equations through practice
Discover the rules of simplifying equations in Boolean algebra through practice

PRACTICAL WORK3: Study and realization of usual combinatorial logic functions
Example: switching circuits (MUX, DMUX), coding and decoding circuits, etc.

PRACTICAL WORK4: Study and realization of an arithmetic combinatorial circuit
Realization of an adder and/or subtractor circuit of 2 binary numbers with 4 bits.

PRACTICAL WORK5: Study and realization of a logical combinatorial circuit
Realization of a logic function using logic gates. Example a 7-segment display and/or a generator of the complement to 2 of a 4-bit number and/or generator of the 4-bit Gray code, ...

PRACTICAL WORK6: Study and realization of a logical combinatorial circuit
Complete study (Truth Table, Simplification, Flowchart, Practical Assembly and Tests) of a combinatorial circuit based on a specification.

PRACTICAL WORK7: Study and construction of meter circuits
Incomplete asynchronous counter circuits using toggles, Irregular cycle synchronous counter circuits using toggles

PRACTICAL WORK8: Study and production of registers

Method of evaluation:

Continuous assessment: 100%

Bibliographical references:

1. J. Letocha, Introduction aux circuits logiques, Edition Mc-Graw Hill.
2. J.C. Lafont, Cours et problèmes d'électronique numérique, 124 exercices avec solutions, Edition Ellipses.

Semester: 4
Course Unit: UET 2.2
Subject 1: Information and communication technology
VHS: 45 hours (Course: 1.5 hours & Workshop: 1.5 hours)
Credits: 2
Coefficient: 2

Teaching objectives:

The objective of this course is to develop in students the transversal skills necessary for the communication of scientific knowledge. It aims to master documentary research and the use of digital tools (ICT) to collect and organize information, to write clear and well-structured scientific documents (introduction, methodology, results, discussion according to the IMRaD scheme), to make convincing oral presentations adapted to the audience, and to respect the rules of ethics and integrity (in particular intellectual integrity when citing sources). The course emphasizes the clarity and conciseness of the scientific style – writing must be "precise, clear, concise" – as well as the ethics of communications (avoiding plagiarism, citing sources correctly, etc.).

Prerequisites:

Students must have a scientific baccalaureate or equivalent, with a good command of written and oral French. Basic computer skills are recommended (word processing, Internet browsing, messaging).

Material content:

Chapter 1: Introduction to Science Communication 1 weeks

Presentation of the course, challenges of scientific communication (written and oral), examples of materials (articles, reports, presentations). Raising awareness of the importance of integrity and ethics in academic work.

Chapter 2: Documentary research and ICT 1 weeks

Introduction to online information search: search engines, university databases (Google Scholar, Persee, digital libraries). Using Boolean operators (AND, OR, EXCEPT) to refine searches. Presentation of basic digital skills (word processing, spreadsheets, presentation software).

Chapter 3: Referencing and bibliography 1 weeks

Principles of citation and bibliographic standards (APA, IEEE, other formats). Anti-plagiarism rules: how to quote and paraphrase correctly. Importance of scrupulously noting all bibliographical elements. Introduction to reference management software (Zotero, Mendeley).

Chapter 4: Structure of a scientific paper 1 weeks

Presentation of the standard structure of an article or report (IMRaD diagram): role of each part (introduction, methodology, results, discussion, conclusion). Importance of a clear and informative Entitled. Discussion of the general logic of the document (problematic, hypotheses).

Chapter 5: Writing of the scientific paper 3 weeks

Writing the introduction and abstract:

How to write an effective introduction: presentation of the context, formulation of the research question and objectives. Write an informative abstract: structure (context, objective, methods, results, conclusion) and keywords. Techniques to hook the reader from the start.

Writing of the methodology and results:

Writing tips for the methodology section (precise description of procedures, materials, conditions) and results (clear presentation of data, use of tables/figures). Distinction between facts (results) and interpretation (discussion). Rules of clarity: simple sentences, active voice/verb precision.

Discussion, conclusion and style:

Write the discussion (put the results into perspective, compare it to other work) and formulate a concise conclusion. Rules of style in scientific writing: clarity, conciseness and precision of language, management of coherence and cohesion (logical connectors). Common mistakes to avoid.

Chapter 6: Introduction to Oral Presentation and Speaking Skills 2 weeks

Oral presentation methodology: prepare a plan (introduction, development, conclusion), define its objective and know its audience. Importance of an engaging introduction (hook), of a summary conclusion.

Speaking techniques:

Body and vocal techniques to capture attention: posture, gestures, gaze, variations in tone and rhythm. Management of stress and stage fright. Best practices: don't read your notes word for word, only take keywords with you to avoid "sleeping" the audience. Use of media (paper, slides).

Chapter 7: Visual aids and ICT for the presentation 1 weeks

Use of computer tools (PowerPoint, Beamer...) to create slides. Basic principles: Readable and uncluttered slides (KISS), use of relevant diagrams/images, appropriate font and colors. Don't overload the slides. Demonstration of screen capture or editing software for scientific content search (Zotero, databases, Google Drive).

Chapter 8: Professional Writing 1 weeks

Written communication techniques outside the article: writing academic emails (clear subjects, polite greetings), meeting minutes, project summaries. Notions of formal style (objectivity, impersonality). Spelling and grammar – Exam of common errors (agreements, conjugation, word confusion).

Chapter 9: Interpersonal Communication and Listening 1 weeks

Dynamics of group communication: active listening, argumentation, reformulation. Role of the oral in teamwork. Techniques for presenting and defending ideas in a debate or small group.

Chapter 10: Ethics and Academic Integrity 1 weeks

Principles of academic ethics: integrity, intellectual honesty, respect for results and people. Examples of breaches (plagiarism, data fabrication, usurpation of authors). Presentation of national university charters and regulations (obligations and sanctions). To emphasize the importance of "intellectual integrity" in research.

Chapter 11: Scientific Standards and Practices 1 week

Summary of international publication standards (peer-Examed journal, impact factor, peer-Exam). Standard formats (APA, etc.) seen earlier. Rules for the presentation of examinations and reports (margins, font, pagination). Introduction to writing a mini-project or internship report.

Workshops:

Workshop: Note-taking exercise during a short video or a scientific text; sharing of effective note-taking techniques (active listening, keywords, organization).

ATL 2: Bibliographic research workshop: find 5 relevant references on a given theme, download them or extract summaries; critical evaluation of the reliability of the sources (evaluator, date, content).

ATL 3: Citation exercise: identify and format references in a given text. Creation of a bibliography according to a given style.

ATL 4: Writing a detailed plan (IMRaD) for a given research topic (e.g., a simple scientific problem), identifying the key ideas of each section.

ATL 5:

- Writing a 150-200 word abstract from a scientific paper or a short presentation provided. Exercises in reformulating arguments for the introduction.
- Writing exercise: briefly describe a simple method or experiment based on a given protocol. Creation of tables or graphs from simulated data.
- Revision workshop: starting with a deliberately confusing scientific paragraph, rework the wording to make it clearer and more concise. Correction of long or convoluted sentences.

ATL: 6

- Presentation preparation exercise: each student prepares a mini oral plan on a simple topic in a few minutes, then presents it briefly. Feedback on argumentation and structure.
- Short individual oral presentations on a familiar theme, with optional video recording. Self-evaluation and feedback from the group on voice and gestures.

ATL 7: Creation of a short slide show (3–5 slides) on a simple scientific topic. Discussions on visual effectiveness.

ATL 8: Writing a professional e-mail to a teacher or supervisor (request for information, project submission). Collaborative correction of a text to eliminate common mistakes.

ATL 9: Role-play: structured debate on a scientific topic (with turn-taking), or peer-to-peer feedback on a mini-presentation.

ATL 10: Formatting in Word or LaTeX of a standard document (cover page, table of contents, chapters, bibliography).

Evaluation method:

Exam: 100%.

Bibliographical references:

1. D. Lindsay & P. Poindron (2011), Guide de rédaction scientifique : L'hypothèse, clé de voûte de l'article scientifique, Éditions Quae, Versailles.
2. J.E. Harmon & A.G. Gross (2010), The Craft of Scientific Communication, University of Chicago Press.

3. Ministère de l'Enseignement Supérieur et de la Recherche Scientifique (Algérie), Charte d'éthique et de déontologie universitaires, 2010 (voir notamment l'accent sur l'intégrité académique), https://www.mesrs.dz/index.php/fr/ethique-et-deontologie/charte-ethique-et-deontologie/.
4. Baril. D (2008), Techniques de l'expression écrite et orale, Sirey .
5. Jean-Denis Commeignes (2013), 12 méthodes de communications écrites et orale – 4éme édition, Michelle Fayet et Dunod.
6. Cardon, D. (2019). *Culture numérique,* Paris, Presses de Sciences Po
7. Frédéric Wauters (2023). Rédiger efficacement à l'ère du digital Techniques de communication écrite, 2e édition - ISBN 978-2-8073-3772-5.
8. Chartier, M. (2013). Le guide du référencement web. First.
9. Duarte, N. (2019). *DataStory: Explain Data and Inspire Action Through Story* Story Paperback. IdeapressPublishing.ISBN-10 : 1940858984
10. Levan, S. K. (2000). *Le projet Workflow* Concepts et outils au service des organisations. Eyrolles.
11. Anderson, C. (2016). *TED Talks: The Official TED Guide to Public Speaking* (1st edition). Houghton Mifflin Harcourt.
12. Reynolds, G. (2009). *Présentation Zen : Pour des présentations plus simples, claires et percutantes* . Pearson.
13. Thierry , L. (2014). Introduction à la communication - 2ème. Dunod.
14. Serres, A. (2021). *Dans le labyrinthe : Évaluer l'information sur internet*. C&F Éditions.

Semester: 5
Course Unit: UEF 3.1.1
Topic 1: Control of linear systems
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives:

This module is a consolidation of the knowledge acquired in the second year and allows the mastery of the representation of dynamical systems and their properties in state space as well as the acquisition of the main methods of analysis and synthesis of control systems.

Recommended prior knowledge:

Basic mathematics. Continuous and sampled linear systems.

Material content:

Chapter 1. Calculation of controllers in the frequency domain (4 weeks)

Frequency response and frequency properties of controllers (P, PI, PID, PD, phase advance, phase delay, phase advance), Specification in the frequency domain (gain and phase margin, resonance factor, bandwidth, their interpretations), Calculation of controllers using the Bode diagram, Adjustments using the Black-Nichols chart.

Chapter 2. System Status Representation (2 weeks)

Introduction, Concepts (state, state variables, ...), State representation of continuous linear systems, State representation of discrete systems, Canonical forms, State representation of nonlinear systems, Linearization.

Chapter 3. Analyzing systems in the state space (3 weeks)

Solving equations of state and transition matrix, Transition matrix calculation methods, Modal analysis (diagonalization), Stability, Notions of commandability and observability (definitions and test methods).

Chapter 4. Status feedback control (3 weeks)

Formulation of the Pole Placement Problem by State Feedback, Computational Methods for Monovariable Systems, Cases of Multivariate Systems, Implementation.

Chapter 5. Summary of the status observers (3 weeks)

Introduction, Deterministic observers (Luenberger) and calculation methods, Reduced observers, Stochastic observers (Kalman filter).

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. Philippe de Larminat, « Automatique : Commande des systèmes linéaires », Hermès Lavoisier, 1996.
2. Hubert Egon, « Asservissement linéaires échantillonnés et représentation d'état », Méthodes, 2001.
3. Luc Jaulin, « Représentation d'état pour la modélisation et la commande des systèmes », Lavoisier, 2005.
4. Robert L. Williams, Douglas A, «Lawrence, Linear State-Space Control Systems », Edition John Wiley & Sons, 2007.
5. R. Longchamp, « Commande numérique de systèmes dynamiques », Presses Polytechniques et Universitaires Romandes, 1995.
6. G. F. Franklin, J. D. Powell, L. M. Workman, «Digital control of dynamic systems», Addison-Wesley Series in Electrical and Computer Engineering: Control Engineering, 1990.
7. K. J. Aström, B. Wittenmark, « Computer controlled systems: theory and design», Prentice-Hall, 1984.
8. R. H. Middleton, G. C. Goodwin, « Digital control and estimation: a unified approach», Prentice Hall, 1990.

Semester: 5
Course Unit: UEF 3.1.1
Material 2: Power Electronics
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives:

To know the basic principles of power electronics, To know the operating principle and the use of power components, To master the operation of the main static converters, To acquire the basic knowledge for a technical choice according to the field of application of a power converter.

Recommended Prior Knowledge

Fundamental Electronics1, Fundamental Electrical Engineering1.

Content of the material:

The number of weeks displayed is given as an indication. It is obvious that the course leader is not required to strictly respect this sizing or the arrangement of the chapters.

Chapter 1. Introduction to Power Electronics **3 weeks**

Introduction to power electronics, its role in electrical energy conversion systems. Introduction to static converters. Classification of static converters (according to the switching mode, according to the conversion mode). Non-sinusoidal periodic quantities (rms, averages, form factor, ripple rate).

Chapter 2. AC to DC converters **3 weeks**

Power Elements (Diodes and Thyristors), Single-Phase Rectifier, Load Type R, RL, RLE., Rectifiers-Three-Phase, Load Types R, RL, RLE. Analysis of the switching (encroachment) phenomenon in uncontrolled and controlled static rectifier converters.

Chapter 3. AC - AC Converters **3 weeks**

Power elements (triacs with quick reminder on diodes and thyristors), Single-phase dimmer, with R load, RL. Principle of the single-phase cycloconverter

Chapter 4. Direct current to direct current converters **3 weeks**

Power elements (GTO thyristor, bipolar transistor, MOSFET transistor, IGBT transistor), step-down chopper and booster, with R, RL and RLE load.

Chapter 5. Direct current to alternating current converters **3 weeks**

Single-phase inverter, half-bridge and bridge mounting with R and RL load.

Method of evaluation:

Continuous assessment: 40%; Final exam: 60%.

Bibliographical references:

1. L. Lasne, « Electronique de puissance : Cours, études de cas et exercices corrigés », Dunod, 2011.
2. P. Agati et al. « Aide-mémoire : Électricité-Électronique de commande et de puissance–Électro-technique », Dunod, 2006.
3. J. Laroche, « Électronique de puissance – Convertisseurs : Cours et exercices corrigés », Dunod, 2005.
4. G. Séguier et al. « Électronique de puissance : Cours et exercices corrigés », 8e édition; Dunod, 2004.
5. D. Jacob, « Electronique de puissance - Principe de fonctionnement, dimensionnement », Ellipses Marketing, 2008.

6. G. Séguier, « L'électronique de puissance, les fonctions de base et leurs principales applications », Tech et Doc.
7. H. Buhler, « Electronique de puissance », Dunod
8. C.W. Lander, « Electronique de puissance », McGraw-Hill, 1981
9. H. Buhler, « Electronique de Réglage et de commande ; Traité d'électricité ».
10. F. Mazda, "Power Electronics Handbook: Components, Circuits and Application", 3rd Edition, Newness, 1997.
11. R. Chauprade, « Commandes des moteurs à courant alternatif (Electronique de puissance) », 1987.
12. R. Chauprade, « Commandes des moteurs à courant continu (Electronique de puissance) », 1984.

Semester: 5
Course Unit: UEF 3.1.1
Subject 3: Modelling and identification of systems
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

The objective of this course is to present fundamental notions and basic methods that allow an automation engineer to develop representation models describing the input-ouPractical Workut behavior of a process to be controlled in order to develop an efficient regulator.

Recommended prior knowledge:

Basics in Mathematics and Slave Systems.

Material content:

Chapter 1. Modeling (3 weeks)
Representation model, Knowledge model (modeling of mechanical, electrical, fluidic, thermal systems, etc.).

Chapter 2. Reminder of the basic methods in Automatic (4 weeks)
Temporal response of a system, Direct identification from the temporal response, Frequency approach.

Chapter 3. Model fit principle (4 weeks)
Linear model with respect to parameters, Minimization of the fit criterion and calculation of the optimal solution, Matrix writing of the least-squares method.

Chapter 4. Analysis of the method of the leastsquares (3 weeks)
Estimation bias, Variance of the estimate, Estimator of the maximum likelihood, Rejection of outliers.

Chapter 5. Recursive Least Squares (1 week)
Principle of recursive calculus, Implementation of the recursive method, Weighting factor, Forget factor.

Evaluation method:

Exam: 100%.

Bibliographical references:

1. Jean-François Massieu, Philippe Dorléans, « Modélisation et analyse des systèmes linéaires », Ellipses, 1998.
2. Pierre Borne, Geneviève Dauphin-Tanguy, Jean-Pierre Richard, « Modélisation et identification des processus », Technip, 1992.
3. Ioan D. Landau, « Identification des systèmes », Hermès, 1998.
4. E. Duflos, Ph. Vanheeghe, « Estimation Prédiction », Technip, 2000.
5. R. Ben Abdenour, P. Borne, M. Ksouri, M. Sahli, « Identification et commande numérique des procédés industriels », Technip, 2001.

Semester: 5
Course Unit: UEF 3.1.2
Subject 1: Microprocessors and Microcontrollers
VHS: 67.5 hours (Lecture: 3 hours, TUTORIAL: 1.5 hours)
Credits: 6
Coefficient: 3

Teaching objectives:

This course provides students with an understanding of how microprocessors work, their peripherals, and how they interface. It also allows them to become familiar with the different types of ECUs used in industrial facilities.

Recommended prior knowledge:

Combinatorial and sequential logic, Notions of programming.

Material content:

Chapter 1. Microprocessor architecture (2 weeks)

Introduction to Microprocessor-Based Systems, External Architecture of a Microprocessor, Internal Architecture of a Microprocessor.

Chapter 2. Introduction to the instruction set and interrupts (4 weeks)

The instruction set, The mnemonic code, The addressing modes, The interrupts.

Chapter 3. Memoirs (2 weeks)

Introduction, Memory Technology: ROM, RAM, Refresh Techniques, Memory Characteristics, Addressing Modes.

Chapter 4. Interfaces (2 weeks)

Serial interface, Parallel interface.

Chapter 5. The microcontroller (5 weeks)

General information on the microcontroller, Microcontroller architecture, Peripherals, Interrupts, Microcontroller programming, Practical application.

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. A. Farouki, T. Laroussi, T. Benhabiles, « Microprocesseurs 8086 », Univ. Constantine.
2. J. Y. Haggège, « Microprocesseur : Support de cours », INSET, 2003.
3. Lilen, « Cours fondamental des microprocesseurs », Dunod, 1993.
4. Alain-Bernard Fontaine, « Le Microprocesseur 16 bits-8086-8088 », 2ième édition, Manuels informatiques», Masson, 1997.
5. Michel Aumiaux, « Microprocesseurs 16 bits », 1997.
6. J. Crisp,« Introduction to microprocessors and microcontrollers», Elsevier, 2nd edit 2004.
7. Christian Tavernier, « Microcontrôleurs PIC 10, 12, 16, Description et mise en œuvre », Dunod, 2007.
8. Pascal Mayeux, « Apprendre la programmation des PIC Mid-Range par l'expérimentation et la simulation », Dunod, 2010.

Semester: 5
Course Unit: UEF 3.1.2
Subject 2: Programming in C++
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

This course will allow the student to become familiar with programming languages and in particular the C++ language.

Recommended prior knowledge:

Basics in mathematics, Notions of algorithmics, Numerical methods, Binary logic.

Material content:

Chapter 1. Introduction to the C++ language (1 week)
History, Development environment in C++ (creation of objects, compilation, debugging, execution...).
Chapter 2. Syntax Elementary in C++ language (1 Week)
Instructions Comments, Keywords and Reserved Words – Constants and Variables, Fundamental Types Operators (Unitary, Binary, Priority,...).
Chapter 3. Conditional Structures and Loops (2 weeks)
If/else, Switch/case, Loop for, Loop while, Loop do/while.
Chapter 4. Inputs/ouPractical Workuts (2 weeks)
OuPractical Workut Field for display, Keyboard input Field, Case of strings, files.
Chapter 5. Pointers and Tables (2 weeks)
Pointers, References, Static Arrays, Arrays and Pointers, Dynamic Arrays, Multidimensional Arrays.
Chapter 6. Functions (2 weeks)
Prototype a Function, Define a Function, Call a Function, Pass Arguments to a Function, Override a Function, Files.
Chapter 7. Object-Oriented Programming in C++ (5 weeks)
Introduction, Concept of classes and objects, Inheritance, Special methods (constructors, destructors...), Procedural or structured programming, Object-based programming.

Evaluation method:

Exam: 100%.

Bibliographical references:

1. Bjarne Stroustrup, Marie-Cécile Baland, Emmanuelle Burr, Christine Eberhardt, « Programmation: Principes et pratique avec C++ », Edition Pearson, 2012.
2. Jean-Cédric Chappelier, Florian Seydoux, « C++ par la pratique. Recueil d'exercices corrigés et aide-mémoire », PPUR Édition : 3e édition, 2012.
3. Jean-Michel Léry, Frédéric Jacquenot, » Algorithmique, applications aux langages C, C++ en Java », Edition Pearson, 2013.
4. Frédéric DROUILLON, « Du C au C++ - De la programmation procédurale à l'objet », Eni; Édition : 2e édition, 2014.
5. Claude Delannoy, « Programmer en langage C++ », Edition Eyrolles, 2000.
6. Kris Jamsa, Lars Klander, « C++ La bible du Programmeur », Edition Eyrolles, 2000.
7. Bjarne Stroustrup, « Le Langage C++ », Édition Addison-Wesley, 2000.

Semester: 5
Course Unit: UEM 3.1.1
Material 1: Practical work Control of Linear Systems
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

Consolidate the knowledge acquired during the course of the corresponding theoretical subject through practical work.

Recommended prior knowledge:

Continuous servo systems, Study of systems in the frequency domain and in state space.

Material content:

Lab 1: Getting Started with MATLAB/Simulink

PRACTICAL WORK2: Study and synthesis of regulators in the frequency domain

PRACTICAL WORK3: The representation of state in canonical forms

PRACTICAL WORK4: Study and analysis of systems in state space

PRACTICAL WORK5: Study and synthesis of regulators by pole placement

PRACTICAL WORK6: Study and synthesis of the state observers

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Course Unit: UEM 3.1.1
Subject 2: PRACTICAL WORK Power Electronics
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

The aim is to understand the operation and characteristics of the different types of basic converters and their applications to machines.

Recommended prior knowledge:

Content of the Power Electronics course.

Material content:

PRACTICAL WORK N° 1. Non-controlled rectifiers: single-phase and three-phase
Analyze the evolution of the voltage and current at the ouPractical Workut of the converter with resistive and inductive loads, Analyze the evolution of the semiconductor currents and voltages in both the case of resistive and inductive loads, Determine the form factor and the ripple rate.

PRACTICAL WORK N° 2. Controlled, single-phase and three-phase rectifiers
Analyze the evolution of the voltage and current at the ouPractical Workut of the converter with resistive and inductive loads, Analyze the evolution of the semiconductor currents and voltages in both the case of resistive and inductive loads, Determine the form factor and the ripple rate.

PRACTICAL WORK N° 3. Choppers, Serial Chopper, Parallel Chopper
To study the behaviour of a series chopper on the inductive load and in particular to determine the shape of the current absorbed by the load during operation in a transient and then a steady state, To understand the operation by observing the characteristic signals of the assembly and comparing them to the results of the TUTORIAL on the parallel chopper.

PRACTICAL WORK N° 4. Single-phase inverters
To study the operation of single-phase voltage inverters and on the other hand the filtering of the waveforms obtained. "Active" and "passive" filtering solutions will be discussed.

PRACTICAL WORK N° 5. Single-Phase and Three-Phase AC Voltage Controllers
To study the operation of a dimmer dispensing different types of loads (R and R-L) and to compare the different results obtained theoretically in class with the practical results (formulas and chronograms).

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Course Unit: UEM 3.1.1
Subject 3: Practical work Modelling and identification of systems
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

The purpose of these labs is to put into practice the modeling and identification methods presented in the course.

Recommended prior knowledge:

The student must be proficient in computer tools, in particular simulation by the MATLAB Simulink toolbox, Modeling and System Identification course.

Material content:

PRACTICAL WORK1: Introduction to MATLAB/Simulink

PRACTICAL WORK2: Simulation of a System Described by the Equation of State and Transfer Function (Simulink)

PRACTICAL WORK3: Nonparametric identification by the deconvolution method

PRACTICAL WORK4: Nonparametric identification by the Correlation Method

PRACTICAL WORK5: Parametric identification by the Broida method

PRACTICAL WORK6: Least Squares Method

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Course Unit: UEM 3.1.2
Subject 1: Microprocessors and Microcontrollers
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

Acquire the ability to implement a small system based on microcontrollers and microprocessors through the knowledge of the main families and the operation of a microcontroller and its peripherals.

Recommended prior knowledge:

Basic knowledge of digital electronics (Boolean logic, logic gates, toggles, counters, registers), Computer architecture, Knowledge of an assembly language.

Material content:

PRACTICAL WORK1: Getting started with the 6809/8086 emulator

PRACTICAL WORK2: Arithmetic and logical operations on the microprocessor

PRACTICAL WORK3: Application of the different addressing modes

PRACTICAL WORK4: Interruptions

PRACTICAL WORK5: Learning to program with a PIC 16F84

PRACTICAL WORK6: Controlling a display (7 segments, LCD)

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Course Unit: UEM 3.1
Subject 2: Practical work Programming in C++
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

This module will allow the student to put into practice and consolidate the knowledge acquired in the C++ programming module.

Recommended prior knowledge:

C++ programming module

Material content:

Lab 1: Familiarization with the C++ language
(Development environment , compilation, debugging, execution...)

Lab 2: Basic syntax, declaring variables and operators

Lab 3: Conditional structures and loops

Lab 4: Tables and Pointers

Lab 5: Functions

PRACTICAL WORK 6: Files

Lab 7: Object-Oriented Programming in C++
Classes, Special Methods (Constructors, Destructors...), Inheritance

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Course Unit: UED 3.1
Subject 1: Standards and Certification
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

The objective of this course is to give the student the basic elements to understand what an industrial standard and certification is, while explaining the differences, levels and types of existing certifications and the institutions that can issue such certificates.

Recommended prior knowledge:

None.

Material content:

Chapter 1. Introduction (1 week)
- Definitions (ISO/IEC 2 2004 guide) Standardization, norm, standard, consensus. Comments

Chapter 2. Standardization Objectives and Standardization Benefits (1Week)
- Reminder of the history of quality: from craftsmanship to the digital industry
-Quality and quality assurance
-Roles of standardization
- Advantages of a quality system (ISO 9000 for example)

Chapter 3. Trade legislation (1 week)
- Law, decree, circular, etc., regulatory text and standard
- Standardization and economic actors
Examples: PC vs. Apple computer, IBM PC vs. PC compatible
-Quality control and compliance laboratories
- Border control: health, product quality, health impacts, economic techniques , policies (protectionism)

Chapter 4. Types of standards and organization of standardization work (2 weeks)
-Notion of voluntary norm
- Internal or local organizations: European and American organizations, Algerian organizations
- International organizations: CGPM and the SI system, ISO, EN standards, specific standards in electricity and telecommunications

Chapter 5. Standards development, standardization and safety (3 weeks)
- Manufacture of standards: the case of Afnor and Ianor, organization and functioning of Algerian standardization, process of elaboration of Algerian standards
- Main legal texts relating to standardization in Algeria
-Standardization and security
-Applications to domestic electrical security:
- Realization of a compliant domestic electrical installation (example of the nfc18510 standard): distribution of circuits (according to their use), choice of wire sections and line circuit breakers.
- Realization of the earthing connection according to standards

Chapter 6. Certification (4 weeks)
-Accreditation

-Certification
-Different types of certification most common in Algeria (and partly financed by the state)
-Certification process

Chapter 7. ISO 9000 standards **(2 weeks)**

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Description-The ISO 9000 Family
- Scope of the different ISO 9000 standards
- Important notes on ISO 9001:2015 and ISO 9004:2015

Evaluation method:

Exam: 100%.

Bibliographic reference:

1. Robert Obert, « Pratique des normes IFRS, Comparaison avec les règles françaises et les US GAAP », Dunod, 2004.
2. Daniel Boeri, Maîtriser la qualité: tout sur la certification et la qualité totale, Editions Maxima, 2003, p. 26. (ISBN 2840013134)
3. Norme ISO 9000:2015 « Système de management de la qualité – Principes essentiels et vocabulaire »
4. Norme, ISO 9001: 2015 « Système de management de la qualité –Exigences https://fr.wikipedia.org/wiki/S%C3%A9rie_des_normes_ISO_9000
5. Annexe D : habilitation, recyclage, référentiel ED6127 : schéma général de formation et de recyclage à l'habilitation dans la norme nfc18510_inrs_habilitation.
6. Catalogue 2014 des normes algériennes document pdf 447 pages (téléchargement libre) http://www.ianor.dz/Site_IANOR/Catalogue.php?id=8
7. Liste des Organismes accrédités par Algerac : certification, inspection, essais-analyses, etc. (màj 14/09/2017)

Semester: 5
Course Unit: UED 3.1
Material 2: Renewable Energies: Production and Storage
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

This course allows the student to know the principles of electricity production from renewable energies, in order to be able to propose renewable alternatives for the production of electrical energy.

Recommended prior knowledge:

Energy and environment courses

Material content:

Chapter 1. General information on energy **(3 weeks)**
Definition, measurement, power and energy.

Chapter 2. The different types of energy and their transformation **(3 weeks)**

Chapter 3. Main sources of electricity production **(3 weeks)**
Fossil and renewable.

Chapter 4. Principle of production from solar and wind power **(2 weeks)**

Chapter 5. Stand-alone energy sources with storage systems **(4 weeks)**
Batteries, capacitors, others.

Evaluation method:

Exam: 100%.

Bibliographical references:

1. Jean-Christian Lhomme, Alain Liébard, « Les énergies renouvelables », Delachaux &Niestlé, Édition : 2e édition, 2004.
2. Leon Freris et David Infield, « Les énergies renouvelables pour la production d'électricité », Dunod, 2013.
3. Philippe Terneyre, « Energies renouvelables : Contrats d'implantation : Implantation des unités de production, clauses supensives, modèles de contrats », Sa Lamy, avril 2010.
4. Michel Lavabre et Fabrice Baudoin, « Exercices et problèmes de conversion d'énergie : Tome 5, Energies renouvelables (1) : aérogénérateurs, gestion et stockage d'énergie », Casteilla, 2010.

Semester: 5
Course Unit: UET 3.1
Subject 1: Simulation Software
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:
To know simulation software, to be able to reproduce an electro-energetic system with a view to its study and simulation.

Recommended prior knowledge:
Notions of programming, notions of Matlab.

Material content:

Chapter 1: Getting Started with MATLAB (02 weeks)

1.1 - Introduction
1.2 - MATLAB Environment
1.3 - Getting Started with MATLAB
Command Window, Defined Variables Window (Workspace), Working Directory Window, Command History Window
1.4 - Presentation and general
Get Help, Getting Started, The Workspace, Instruction-Line Syntax, Managing Working Directory Files, Arithmetic Operations, Scalar Operations and Functions, Special Variables and Constants, Number Format and Calculation Accuracy, Order History

Chapter 2: Data Types and Variables (02 weeks)

2.1 - Types of data
2.2 - Variables
Complex numbers, Boolean variables, Strings, Vectors, Matrices, Polynomials.

Chapter 3: Graphs (01 week)

3.1 - Managing Graphics Windows
3.2 - 2D Graphical Representation
Cartesian coordinate graphs, Improve the readability of a figure, Polar coordinate graphs, Diagrams.
3.3 - 3D graphics
3D Curves, Surfaces

Chapter 4: Programming in MATLAB (02 weeks)

4.1 - Arithmetic operators, logic, and special characters
4.2 - M-Files
4.3 - Scripts and functions
(Scripts, Functions)
4.4 - Control Instructions
(FOR Loop, WHILE Loop, IF Conditioned Statement)

Chapter 5: Getting Started with SIMULINK (03 weeks)

5.1 - SIMULINK Libraries
Libraries Sources, Sinks, Continuous, Math *Operations,Commonly* Used Blocks, Signal Routing,Logic and Bit *Operations,User-Defined* Functions, Ports & Subsystems,.....
5.2- Quick to get started
5.3 - Masks and subsystems
5.2.1 - Subsystems
5.3.2 - Masking subsystems

Subsystem Masking, Using Callbacks
5.4 - Study of some simulation examples

Chapter 6: Power System Blockset (PSB) (02 weeks)

6.1 - Introducing the Power System Blockset
6.2 - Study of a simulation example

Chapter 7: Simulation and co-simulation with other software (03 weeks)

7.1 - PSim Simulation and Simulink-PSim Co-Simulation
7.2 - Simulation with other software: PSpice, Proteus, Scilab,....

Evaluation method:

Exam: 100%.

Bibliographical references:

1. A. Lanton, "Méthodes et outils de la simulation", Edition, Hermès, 2000.
2. Documentation de Matlab on-line.

Semester: 6
Course Unit: UEF 3.2.1
Material 1: Sampled-Data Control Systems
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives:

To know the techniques of sampling and signal reconstruction, To be able to study the stability and evaluate the accuracy of a sampled slave system, To apply some methods of analysis and synthesis of sampled slave systems.

Recommended prior knowledge:

Linear Continuous-Time Control Systems, Basic mathematics (Algebra, analysis, ...).

Material content:

Chapter 1. Structure of a numerical control system (1 week)
History, Advantages and Disadvantages of CNC Control, General Structure of a CNC System, A/D and D/A Conversions, Samplers/Blockers.

Chapter 2. Signal sampling (2 weeks)
Modeling of A/D and D/A Converters, Sampling, Signal Construction, Blockers, Z-Transmittance and Frequency Response of a BOZ (Zero-Order Blocker), Shannon's Sampling Theorem, Practical Considerations.

Chapter 3. Representation of sampled systems (3 weeks)
Definitions, Representation by Difference Equations, Advance/Delay Operators, Representation by Impulse Response, Z Transform, Z-Transmittance and Block/Diagram Simplification, Poles/Zero Transformation by Sampling.

Chapter 4. Analysis of sampled systems (4 weeks)
Stability conditions, Temporal nature of transient signals, Stability criteria (Schur-Cohn, Jury, Routh-Hurwitz, Discrete Nyquist, Discrete Evans Place).

Chapter 5. Synthesis of Sampled-Data Systems (4 weeks)
Introduction, Speed, Static Accuracy, PID Standard Controllers, Synthesis in the p-Plane and Discretization, Synthesis in the Z Plane, Practical Implementation of Controllers.

Chapter 6. RST Controller (1 week)

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. .R. Ragazzini, G. F. Franklin, « Les systèmes asservis échantillonnés », Dunod, 1962.
2. Daniel Viault, Yves Quenec'hdu, « Systèmes asservis échantillonnés », ESE, 1977.
3. Christophe Sueur, Philippe Vanheeeghe, Pierre Borne, « Automatique des systèmes échantillonnés : éléments de cours et exercices résolus », Technip, 5 décembre 2000.
4. P. Borne. G.D.Tanguv. J. P. Richard. F. Rotella, I. Zambetalcis, « Analyse et régulation de processus industriels-régulation numérique », Tome 2-Editions Technip, 1993.
5. Emmanuel Godoy, Eric Ostertag, « Commande numérique des systèmes : Approches fréquentielle et polynomiale », Ellipses Marketing ,2004.

Semester: 6
Course Unit: UEF 3.2.1
Material 2: Actuators
VHS: 45 hours (Lecture: 1.5 hours, TUTORIAL: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives:

The objective of this course is to enable learners to acquire the knowledge necessary to choose the components of the pneumatic, hydraulic, electrical and thermal operating parts. It will also allow them to understand the challenges and solutions available in the field of industrial automation actuators.

Recommended prior knowledge:

Power Electronics, Fundamental Electronics1, Fundamental Electrical Engineering1.

Material content:

Chapter 1: Reminders (2 weeks)

Reminders: Operational and control parts of an automated system, Structure of an automation in pneumatic, electrical, electronic technologies

Interfaces: Interfaces that modify the parameters of a signal; Interfaces that change the nature of a signal

Chapter 2- Pneumatic actuator: The cylinder (2 weeks)

1-Description. 2-Sizing. 3-Limit switches. 4-Different types of cylinders. 5-Example application

Chapter 3 - Precautions for pneumatic actuators: The distributor (2 weeks)

1-Means of control or control. 2-Standardized symbols. 3-Electro dispensers. 4-Distribution auxiliaries. 5-Example of application.

Chapter 4- Electric actuator: The motor (3 weeks)

1- DC motor. 2- Single-phase motor. 3- Stepper motor. 4- Three-phase asynchronous motor.

Chapter 5- Precautionary for electric actuator (2 weeks)

1-Manually operated switchgear: the circuit breaker and the motor circuit breaker. 2-Automatically controlled switching device: the contactor. 3-Electronically controlled switching device: the electronic inverter.

Chapter 6- Recalls: the motor in an electrical installation (1 week)

1-Single-phase and three-phase power supply network. 2-Functional structure of an electrical installation (power and control parts and the different functions). 3-Function of disconnecting or isolating the installation (the disconnector). 4-Power circuit protection (against short circuits, overcurrents, overloads). 5- Switching function. 6-Control circuit protection.

Chapter 7- Three-phase motor control (3 weeks)

1-Coupling of the stator (star, triangle). 2-Rotor coupling (cage or short-circuited, rotor wound). 3-Starting modes (direct, star-triangle, stator resistors, rotor resistors). 4- Braking of three-phase asynchronous motors. 5-Different types of control (manual, semi-automatic, automatic). 6- Example of synthesis:1 - Semi-automatic control -2- Automatic control by PLC.

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. Guy Clerc, Guy Grellet, « Actionneurs électriques, Modèles, Commande », Eyrolles, 1999.
2. Gérard Lacroux, « Les actionneurs électriques pour la robotique et les asservissements », 1994.
3. Pierre Mayé, Moteurs électriques industriels, Dunod, 2011.
4. J. Faisandier, » Mécanismes hydrauliques et pneumatiques », Dunod 1999.
5. R. LABONVILLE, « Conception des circuits hydrauliques, une approche énergétique », Editions de l'Ecole Poly technique de Montréal 1991.
6. P. MAYE, « Moteurs électriques pour la robotique », Dunod Paris 2000.
7. José RoldanViloria, Aide-mémoire de pneumatique industrielle, Dunod, 2015.

Semester: 6
Course Unit: UEF 3.2.1
Topic 3: Sensors and measurement chains
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

After acquiring this unit, the student is expected to master the different elements of a measurement chain, the basic operating principle of a sensor and the metrological characteristics that must be taken into account when using and choosing a sensor.

Recommended prior knowledge:

General Electricity, Electrical and Electronic Measurements.

Material content:

Chapter 1. Notions of measurement chain: (1 week)
Definition, synoptic diagram of an industrial control chain, active and passive sensors, classification of sensors.
Chapter 2. Metrological characteristics of the sensors: (1 week)
Definition, sensor calibration, sensitivity, linearity, accuracy, dynamic sensitivity.
Chapter 3. Sensor conditioning circuit: (3 weeks)
Basic assemblies of operational amplifiers (inverter, non-inverter, differential, summator, etc.). Instrumentation Amplifier, Isolation Amplifier. Conditioning bridges . Linearization of static sensor characteristics.
Chapter 4. Temperature measurement: (3 weeks)
Introduction to Thermometry, Resistance Thermometry, Thermocouple, Thermistor, Pyrometer.
Chapter 5. Pressure measurement: (2 weeks)
Notions of pressure, absolute pressure, relative pressure and differential pressure.
Piezoresistive pressure sensors
Chapter 6. Measurement of levels and flows: (3 weeks)
Float Sensors, Ultrasonic Doppler Sensors
Chapter 7. Measurement of displacements and speed: (2 weeks)
Optical encoders, Incremental encoders, Variable reluctance sensors.

Evaluation method:

Exam: 100%.

Bibliographical references:

1. George Asch et Coll, « les capteurs en instrumentation industrielle », 6ème édition Dunod, 2006.
2. Pascal Dassonvalle, « Les capteurs : 50 exercices et problèmes corrigés », Dunod, 2004.
3. Georges Asch, Patrick Renard, Pierre Desqoutte, Zoubir Mammeri, EricChambérod, Jean Gunther, « Acquisition de données », 3ème édition, Dunod, 2011.
4. FèridBélaïd, « Introduction aux capteurs en instrumentation industrielle », Centre de Publication Universitaire 2006.
5. J. P. Bentley, "Principles of measurement systems", Pearson education 2005.
6. J. Niard et al, « Mesures électriques », Nathan, 1981.

Semester: 6
Course Unit: UEF 3.2.2
Material 1: Programmable logic controllers
VHS: 67.5 hours (Lecture: 3 hours, TUTORIAL: 1.5 hours)
Credits: 6
Coefficient: 3

Teaching objectives:

Identify the technological elements that make it possible to control the operation and monitor an automated production system, Use the tools for specifying an industrial automation system in order to predict a cycle time or a production rate.

Recommended prior knowledge:

Basics of the calculator and programming.

Material content:

Chapter 1. General information on automated systems (2 weeks)
Description of the different parts, Different types of control, Application areas of automated systems.

Chapter 3. The Grafcet (3 weeks)
Description of the Grafcet, Rules of evolution of the Grafcet, Basic structures, Modes of on/off.

Chapter 4. Architecture of Programmable Logic Controllers (3 weeks)
PLC Technology, PLC Environment, External Appearance, Internal Structure, Criteria and Selection of PLCs, PLC Wiring to the Different I/O and Interfaces of an SAP (Automated Production System)

Chapter 5. Programming of a Programmable Logic Controller (7 weeks)
PLC program processing and execution cycles, Different programming languages (Ladder or contact, Boolean or Logical or List Mode, Graph or Flowchart, SFC or grafcet), single-sequence grafcet programming, multi-sequence grafcet programming.

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. Hamdi Hocine, « Automatismes logiques : modélisation et commande », volumes 1 et 2, éditions de L'UMC, 2006.
2. William Bolton, « Les automates programmables industriels », Dunod, 2010.
3. J.C. Humblot, « Automates programmables industriels », Hermes Science Publications, 1993.
4. Simon Moreno, Edmond Peulot, « Le GRAFCET : conception, implantation dans les automates programmables industriels », Delagrave, 2009.
5. Kevin Collins, « La programmation des automates programmable [sic] industriels », Meadow Books, 2007.
6. G. Michel, « Les A.P. I : architecture et applications des automates programmables industriels », Dunod, 1988.

Semester: 6
Course Unit: UEF 3.2.2
Subject 2: Communication Buses and Industrial Networks
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

The purpose of this course is to allow the student to become familiar with the concepts of digital data transmission, more particularly the different types of networks existing in the industrial world. The focus will be on understanding the different topologies with their advantages and disadvantages vis-à-vis a given industrial plant.

Recommended prior knowledge:

Notions of bass on Boolian logic.

Material content:

Chapter 1. Network architecture (2 weeks)

- General information on the networks
- Classification of networks
- Network topologies
- Communication Protocols
- Data transmission techniques

Chapter 2. Fieldbus and industrial local networks (3 weeks)

- Industrial Local Area Networks
- Fieldbus Objectives
- Fieldbus classification

Chapter 3. Bus CAN (Controller Area Network) (3 weeks)

- Classification of CAN buses.
- CAN Communication Protocols
- Representation of CAN frames

Chapter 4. : Sensor actuator interface (AS-I) (3 weeks)

- AS-I Fieldbus Architecture
- AS-I Communication Protocols

Chapter 5. ProfiBus field networks (4 weeks)

- ProFiBus network classification
- Profibus and OSI model (communication protocols)
- Principle of access to the bus in a profibus network

Evaluation method:

Exam: 100%.

Bibliographical references:

1. Pascal Vrignat, « Réseaux locaux industriels - Cours et travaux pratiques », 1999.

2. Jean-François Hérold, Olivier Guillotin, Patrick Anaya, « Informatique industrielle et réseaux », Dunod 2010.
3. Eric DECKE, « Module de cours, Réseaux Locaux Industriels et Bus de Terrain », polycopie.
4. Tanenbaum, Andrew, « Réseaux », Dunod 4e édition 2003.
5. Stéphane Lohier, Dominique Présent, « Transmissions et réseaux », Éditions DUNOD
6. Francis Lepage et al, « Les réseaux locaux industriels », Hermes 1991.
7. Fred Halsal, "Mutimedia Communications: Applications, Networks, Protocols and Standards", AddisonWesley, 2001.
8. http://lysjack.free.fr/jack/RLI.htm.

Semester: S6
Course Unit: UEM3.2
Subject 1: End-of-cycle project
VHS: 45 hours (PRACTICAL WORK: 3 hours)
Credits: 4
Coefficient: 2

Teaching objectives:

Assimilate in a global and complementary way the knowledge of the different subjects. Put into practice the concepts instilled during the training in a concrete way. Encourage a sense of autonomy and initiative in the student. To teach him to work in a collaborative framework by arousing intellectual curiosity in him.

Recommended prior knowledge:

The entire Bachelor's program.

Material content:

The theme of the End-of-Cycle Project must come from a concerted choice between the tutor teacher and a student (or a group of students: pair or even trio). The substance of the subject must be in line with the objectives of the training and the real aptitudes of the student (Bachelor's level). It is also preferable that this theme takes into account the social and economic environment of the establishment. When the nature of the project requires it, it can be subdivided into several parts.

Note:
During the weeks during which the students are in the process of immersing themselves in the purpose of their project and its feasibility (bibliographic research, search for software or hardware necessary for the conduct of the project, revision and consolidation of a course with a direct link to the subject, etc.), the subject manager must take advantage of this face-to-face time to remind the students of the essential content of the two subjects.Methodology of writing'' and ''Methodology of presentation'' addressed during the first two semesters of the common core.

At the end of this study, the student must submit a written report in which he or she must set out as explicitly as possible:

- The detailed presentation of the subject of study by insisting on its interest in its socio-economic environment.
- The means implemented: methodological tools, bibliographical references, contacts with professionals, etc.
- The analysis of the results obtained and their comparison with the initial objectives.
- Criticism of the discrepancies noted and possible presentation of other additional details.
- Identification of the difficulties encountered by highlighting the limits of the work carried out and the follow-up to be given to the work carried out.

Finally, the student or group of students presents their work (in the form of a brief oral presentation or on a poster) in front of their tutor teacher and a teacher examiner, who can ask questions and evaluate the work done on a technical and presentation level.

Evaluation method:

Continuous assessment: 100%.

Semester: 6
Course Unit: UEM 3.2
Subject 2: Practical work Sensors and Actuators
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

These practical exercises allow students to exploit and master the theoretical concepts studied in the course.
Teachers must choose four practical exercises suitable for each subject.

Recommended prior knowledge:

Sensors and measurement chains, Actuators.

Material content:

Practical Sensors

PRACTICAL WORK1: Sensor conditioning

PRACTICAL WORK2: Temperature measurement

PRACTICAL WORK3: Pressure measurement

PRACTICAL WORK4: Level measurement and flow rates

PRACTICAL WORK5 : Photometric measurement

PRACTICAL WORK6: Rotational speed measurement

PRACTICAL WORK Actuators

PRACTICAL WORK1: Implementation of a pneumatic system

PRACTICAL WORK2 : Control valve

PRACTICAL WORK3 : Stepper motor

PRACTICAL WORK4: DC and AC motor

PRACTICAL WORK5 : Three-phase motor

Evaluation method:

Continuous assessment: 100%.

Semester: 6
Course Unit: UEM 3.2.1
Material 3: PRACTICAL WORK Programmable Logic Controllers
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:

Once the student has acquired this material, they will be able to understand and implement a basic automated system. Thanks to the different manipulations, he will be able to program a programmable logic controller to intelligently manage and coordinate the actions planned in the specifications that will be presented to him.

Recommended prior knowledge:

Programmable logic controllers course.

Material content:

Plan some practical work in relation to the programmable logic controllers available.

Evaluation method:

Continuous assessment: 100%.

Semester: 6
Course Unit: UEM 3.2.1
Subject 4: Communication Bus and Industrial Networks
VHS: 22.5 hours (PRACTICAL WORK: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

The purpose of these practical exercises is to put into practice the general methods and techniques of data transmission used in communication networks and to understand the specificities of field networks used in automated production chains.

Recommended prior knowledge:

Courses Communications buses and industrial networks.

Material content:

Plan some practical work in relation to industrial networks according to the means available.

Evaluation method:

Continuous assessment: 100%.

Semester: 6
Course Unit: UED 3.2
Subject 1: Electrical installations in automatic
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

To allow the graduate to have an idea of the choice of power supplies installed according to the type of environment, how to connect them to the process and to the other elements of the control and control system.

Recommended prior knowledge:

General electricity, continuous servo systems, fundamental electrical engineering1.

Material content:

Chapter 1. Power supplies (5 weeks)
Low-voltage distribution, grounding, protection and conditioning interface.

Chapter 2. Standardised electrical switchgear and connection diagrams (6 weeks)

Internal overpressure "p", explosion-proof enclosure, protective devices, control devices, use of sensors, standard symbols, electrical connection of PLCs to actuators, implementation of electrical assemblies.

Chapter 3. Instrument Wiring (4 weeks)
Connections between the various elements of the control system, standard cables, instrumentation cables, cables and safe wiring.

On-site visits (which can be found everywhere) will be welcome to complete the student's training in this very important subject from a practical point of view. These visits could be incorporated into the hourly volume.

Evaluation method:

Exam: 100%.

Bibliographical references:

Michel Grout et Patrick Salaun, « Instrumentation industrielle », 3ème édition, DUNOD, 2012.

Semester: 6
Course Unit: UED 3.2
Subject 2: Maintenance and reliability
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

To know the basic concepts of maintenance and dependability, to become familiar with maintenance methods.

Recommended prior knowledge:

Sensors and measuring chains, actuators.

Material content:

Chapter 1. The maintenance function **(2 weeks)**
Definition, maintenance strategies, maintenance standards

Chapter 2. Failure mechanism and modes **(3 weeks)**
Concept of failure, cause of failure, failure mode, failure mechanisms.

Chapter 3. Quantitative Maintenance Analysis **(4 weeks)**
ABC analysis, Noiret's abacus, Decision tree, criticality matrix, correlation relationships.

Chapter 4. Diagnosis **(4 weeks)**
Definition and methodology, conduct of the diagnosis, diagnostic tools (cause-effects table, fault tree, diagnostic diagram, etc.), comparative study of the tools.

Chapter 5. Predictive Failure Analysis **(2 weeks)**

Evaluation method:

Exam: 100%.

Bibliographical references:

1. Jean HENG, « Pratique de la maintenance préventive », Dunod, 2002.
2. Renaud CUIGNET, « Management de la maintenance », Dunod, 2002.
3. Introduction à la TPM, USINOR, Institut Qualité et Management, 1997.
4. « Pratique de la maintenance autonome », USINOR, Institut Qualité et Management 1997.
5. F. MONCHY, Maintenance : méthodes et organisation, Dunod, 2000.
6. J. M. BLEUX, J. L. FANCHON, Maintenance : systèmes automatisés de production, Collection Etapes, Nathan, 1997.

Semester: 6
Course Unit: UET 3.2
Subject 1: Entrepreneurship, Start-Up
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching objectives:

This course aims to introduce students to the fundamentals of entrepreneurship, start-up creation and innovation processes. It will equip students with the skills needed to identify innovative opportunities, develop a viable business concept, and understand the steps that are essential to building a start-up.

Content of the material:

Chapter 1: Introduction to Entrepreneurship (2 weeks)

- Definition and interrelationship between entrepreneurship and innovation
- The entrepreneurial and innovation ecosystem in Algeria
- The different types of innovation (product, process, business model)
- Profile and skills of the innovative entrepreneur

From idea to project

- Identifying opportunities
- Creativity techniques (brainstorming, mind mapping, etc.)
- Case Study: Failure vs. Success

Chapter 2: Identifying Innovative Opportunities (1 weeks)

- Methods for detecting innovation opportunities
- Analysis of the unmet needs of the Algerian market
- Design thinking and user-centered approach
- Creativity and ideation techniques

Chapter 3: Business Model Canvas (3 weeks)

- Components of the Business Model Canvas
- Value Proposition Development
- Customer segmentation
- Distribution channels and customer relations
- Cost structure and revenue sources
- Development of disruptive business models

Chapter 4: Introduction to the Business Plan (2 weeks)

- Structure and key elements of the business plan
- Market research made easy
- Marketing and sales strategy
- Fundamental financial aspects
- SWOT analysis
- Marketing plan, operational plan

Chapter 5: Financing start-ups (3 weeks)

- Sources of funding available in Algeria

- Public entrepreneurship support schemes (ANSEJ, incubators, accelerators, CNAC, ANGEM)
- Venture capital and business angels
- Crowdfunding
- Intellectual Property Protection
- Tax benefits and support specific to innovative start-ups

Chapter 6: Communication and Leadership (1 weeks)

- Oral presentation techniques
- Teamwork, conflict management

Chapter 7: Legal and Administrative Aspects (1 week)

- Legal Forms of Companies in Algeria
- Administrative procedures for creation
- Intellectual Property Protection
- Start-up taxation

Chapter 8: From concept to realization - Implementation of the innovative project (2 weeks)

- Development of a minimum viable product (MVP)
- Testing and validating innovation in the market
- Development of a growth strategy
- Effective presentation of an innovative project (pitch)

Evaluation method: 100% exam

Bibliographical references:

1. Christensen, C. M. (2021). Le dilemme de l'innovateur: Lorsque les nouvelles technologies sont à l'origine de l'échec de grandes entreprises. VALOR.
2. Nezha D.A. ,Mouffok B. (2023). Startups et Entrepreneuriat Le Futur de l'Algérie Éditions universitaires européennes.
3. Osterwalder, A., &Pigneur, Y. (2011). *Business Model Nouvelle Génération : Un guide pour visionnaires, révolutionnaires et challengers*. Pearson.
1. Fayolle, A. (2012). *Entrepreneuriat : Apprendre à entreprendre*. Dunod.
2. Blank, S., &Dorf, B. (2013). *Le Manuel du créateur de start-up : Étape par étape, construisez une entreprise formidable*. Diateino.
3. Ries, E. (2015). *Lean Startup : Adoptez l'innovation continue*. Pearson.
5. Madoui, M. (2015). *Entrepreneurs maghrébins : Terrains en développement*. Karthala.
6. Grim, N. (2012). *Entrepreneurs, Création d'entreprise et Développement*. Éditions universitaires européennes.

IV- Agreements / Conventions

SAMPLE LETTER OF INTENT

(In case of a bachelor's degree co-sponsored by another academic institution)

(Official paper on the letterhead of the university concerned)

Re: Approval of Co-Sponsorship of the Licence enEntitledd:

Hereby, the university (or academic center) declares that it co-sponsors the above-mentioned license during the entire period of authorization of the license.

To this end, the university (or university center) will assist this project by:

- Giving its point of view in the development and updating of teaching programs,
- Participating in seminars organized for this purpose,
- By participating in defense juries,
- By working to pool human and material resources.

SIGNATURE of the legally authorized person:

FUNCTION:

Date:

SAMPLE LETTER OF INTENT

(In case of license in collaboration with a company in the user sector)

(Official paper on company letterhead)

SUBJECT: Approval of the project to launch a Bachelor's degree course enEntitledd:

Provided at:

The company hereby declares its willingness to show its support for this training as a potential user of the product.

To this end, we confirm our support for this project and our role will consist of:

- To give our point of view in the development and updating of teaching programs,
- Participate in seminars organized for this purpose,
- Participate in defense juries,
- To facilitate as much as possible the reception of interns either in the context of end-of-studies theses or in the context of tutored projects.

The means necessary to carry out the tasks incumbent on us for the achievement of these objectives will be implemented on the material and human levels.

Mr. (or Madam)*..... is designated as the external coordinator of this project.

SIGNATURE of the legally authorized person:

FUNCTION:

Date:

OFFICIAL CACHET or COMPANY SEAL

V - Opinions and Endorsements of Administrative and Advisory Bodies

License Entitled: Automatic

Head of Department + Head of the Domain Team
Date and visa:Date and visa:
Dean of the faculty (or Director of the Institute)
Date and visa:
Head of university
Date and visa:

VI – Opinions and Endorsements of the Regional Conference

VII – Opinion and Visa of the National Domain Pedagogical Committee