الجمهورية الجزائرية الديمقراطية الشعبية
Democratic and Popular Republic of Algeria
وزارة التعليم العالي والبحث العلمي
Ministry of Higher education and Scientific Research

University

LOGO

TRAINING OFFER
L.M.D.

ACADEMIC LICENSE

NATIONAL PROGRAMM
2025– 2026

(3rd update)

Establishment	Faculty/Institute	Department

Domain	Sector	Speciality
Sciences and Technologies	***Automatic***	***Automatic***

الجمهورية الجزائرية الديمقراطية الشعبية
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Ministry of Higher education and Scientific Research

اللجنة البيداغوجية الوطنية
لميدان العلوم و التكنولوجيا
Educational Committee
National Domain
Science and
Technology

عرض تكوين
ل. م . د
ليسانس أكاديمية

برنامج وطني
2025 -2026

المؤسسة	الكلية/ المعهد	القسم

الميدان	الفرع	التخصص
علوم و تكنولوجيا	آلية	آلية

II – Half-yearly organization sheets for the specialty courses

Semester 1

Teaching unit (UE)	Subjects	Crédits	Coefficient	Weekly hourly volume			Volume Hourly Biannual (15 Weeks)	Work Complementary In Consultation (15 weeks)	Assessment method	
	Titled			Cours	DW	PW			Control Continuous	Exam
Fundamental EU Code: UEF 1.1.1 Credits: 110 Coefficients: 5	Analysis 1	6	3	1h30	3h00		67h30	82h30	40%	60%
	Algebra 1	4	2	1h30	1h30		45h00	55h00	40%	60%
Fondamental EU Code : UEF 1.1.2 Crédits : 112 Coefficients : 6	Mechanical elements	6	3	1h30	3h00		67h30	82h30	40%	60%
	Structure of matter	6	3	1h30	3h00		67h30	82h30	40%	60%
Méthodological EU Code : UEM 1.1 Crédits : 6 Coefficients : 4	Mechanical element PW	2	1			1h30	22h30	27h30	100%	
	Structure of matter PW	2	1			1h30	22h30	27h30	100%	
	Computer structure and applications	2	2	1h30		1h30	45h00	55h00	40%	60%
Transversale TU Code : UET 1.1 Crédits : 2 Coefficients : 2	Ethical and deontological dimension (the foundations)	1	1	1h30			22h30	02h30		100%
	Careers in science and technology	1	1	1h30			22h30	02h30		100%
Total semester 1		**30**	**17**	**9h00**	**12h00**	**4h30**	**382h30**	**367h30**		

Semester 2

Teaching unit (UE)	Subjects	Crédits	Coefficient	Weekly hourly volume			Volume Hourly Biannual (15 Weeks)	Work Complementary In Consultation (15 weeks)	Assessment method	
	Titled			Cours	DW	PW			Control Continuous	Exam
Fundamental UE Code: UEF 1.2.1 Credits: 10 Coefficients: 5	Analysis 2	6	3	1h30	3h00		67h30	82h30	40%	60%
	Algebra2	4	2	1h30	1h30		45h00	55h00	40%	60%
Fondamental UE Code : UEF 1.2.2 Crédits : 12 Coefficients : 6	Electricity and magnetism	6	3	1h30	3h00		67h30	82h30	40%	60%
	Thermodynamics	6	3	1h30	3h00		67h30	82h30	40%	60%
Methodological TU Code : UEM 1.2 Crédits : 6 Coefficients : 4	Electricity and magnetism PW	2	1			1h30	22h30	27h30	100%	
	Thermodynamics PW	2	1			1h30	22h30	27h30	100%	
	Introduction to Programming	2	2	1h30		1h30	45h00	55h00	40%	60%
Transversal TU Code : UET 1.2 Crédits : 2 Coefficients : 2	Free and open source software	2	2	1h30	1h30		45h00	05h00		100%
Total semester		**30**	**17**	**9h00**	**10h30**	**6h00**	**382h30**	**367h30**		

Semester 3

Teaching unit (UE)	Subjects Titled	Credits	Coefficient	Weekly hourly volume			Volume Hourly Biannual (15 Weeks)	Work Complementary In Consultation (15 weeks)	Assessment method	
				Cours	DW	PW			Control Continuous	Exam
Fondamental UE Code : UEF 2.1.1 Crédits : 10 Coefficients : 5	Analysis 3	6	3	1h30	3h00		67h30	82h30	40%	60%
	Waves and vibrations	4	2	1h30	1h30		45h00	55h00	40%	60%
Fondamental UE Code : UEF 2.1.2 Crédits : 8 Coefficients : 4	Fundamental Electronics1	4	2	1h30	1h30		45h00	55h00	40%	60%
	Fundamental Electrical Engineering 1	4	2	1h30	1h30		45h00	55h00	40%	60%
Méthodological UE Code : UEM 2.1 Crédits : 10 Coefficients : 6	Probabilities and statistics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Python Programing	2	2	1h30		1h30	45h00	5h00	40%	60%
	Electronics and electrical PW	2	1			1h30	22h30	27h30	100%	
	Waves and vibrations PW	2	1			1h30	22h30	27h30	100%	
Discovery UE Code : UED 2.1 Crédits : 2 Coefficients : 2	Energy and environment	1	1	1h30			22h30	02h30		100%
	State of the art of electrical engineering	1	1	1h30			22h30	02h30		100%
Total semester 3		**30**	**17**	**12h00**	**9h00**	**4h30**	**382h30**	**367h30**		

Semester 4

Teaching unit (UE)	Subjects Titled	Credits	Coefficient	Weekly hourly volume			Volume Hourly Biannual (15 Weeks)	Work Complementary In Consultation (15 weeks)	Assessment method	
				Cours	DW	PW			Control Continuous	Exam
Fondamental UE Code : UEF 2.2.1 Crédits : 10 Coefficients : 5	Linear and continuous servo systems	6	3	1h30	3h00		67h30	82h30	40%	60%
	Combinatorial and sequential logic	4	2	1h30	1h30		45h00	55h00	40%	60%
Fondamental UE Code : UEF 2.2.2 Crédits : 6 Coefficients : 3	Signal Theory	4	2	1h30	1h30		45h00	55h00	40%	60%
	Architecture of Automated Systems	2	1	1h30			22h30	02h30		100%
Methodological UE Code : UEM 2.2 Crédits : 12 Coefficients : 7	Numerical methods	5	3	1h30	1h30	1h30	67h30	82h30	40% (20%DW+20%PW)	60%
	Electrical and electronic measurements	3	2	1h30		1h30	45h00	30h00	40%	60%
	Linear and continuous servo systems PW	2	1			1h30	22h30	27h30	100%	
	Combinatorial and sequential logic PW	2	1			1h30	22h30	27h30	100%	
Transversal UE Code : UET 2.2 Crédits : 2 Coefficients : 2	TIC	2	2	1h30	1h30 Workshops		45h00	05h00		100%
Total semester 4		**30**	**17**	**10h30**	**7h30**	**7h30**	**382h300**	**367h30**		

Semestre 5

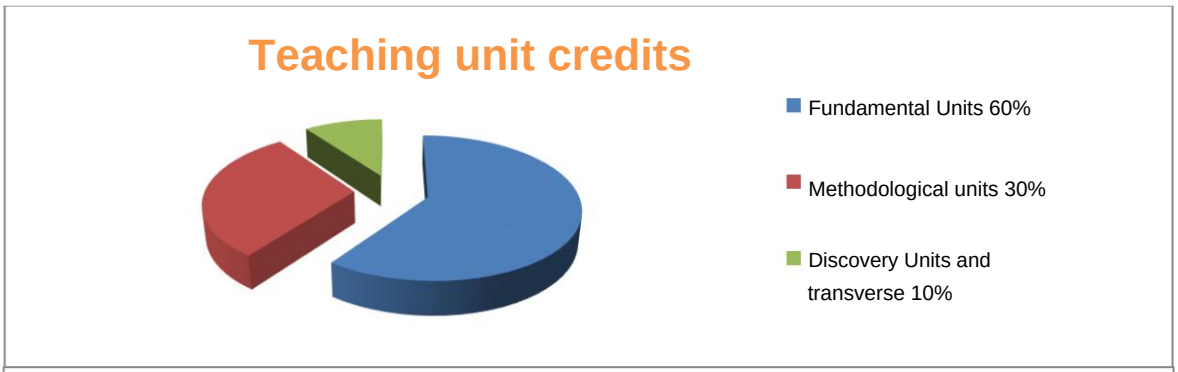
Teaching unit (UE)	Subjects Titled	Credits	Coefficient	Weekly hourly volume			Volume Hourly Biannual (15 Weeks)	Work Complementary In Consultation (15 weeks)	Assessment method	
				Cours	DW	PW			Control Continuous	Exam
Fondamental UE Code : UEF 3.1.1 Crédits : 10 Coefficients : 5	Control of linear systems	4	2	1h30	1h30		45h00	55h00	40%	60%
	Power electronics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Modeling and identification of systems	2	1	1h30			22h30	27h30		100%
Fondamental UE Code : UEF 3.1.2 Crédits : 8 Coefficients : 4	Microprocessors and Microcontrollers	6	3	1h30	3h00		67h30	82h30	40%	60%
	C++ Programming	2	1	1h30			22h30	27h30		100%
Méthodological UE Code : UEM 3.1 Crédits : 9 Coefficients : 5	Control of linear systems PW	2	1			1h30	22h30	27h30	100%	
	Power electronics PW	2	1			1h30	22h30	27h30	100%	
	Modeling and identification of systems PW	2	1			1h30	22h30	27h30	100%	
	Microprocessors and Micro Microcontrollers PW	2	1			1h30	22h30	27h30	100%	
	C++ Programming PW	1	1			1h30	15h00	10h00	100%	
Discovery UE Code : UED 3.1 Crédits : 2 Coefficients : 2	Standars and Certification	1	1	1h30			22h30	02h30		100%
	Electrical Safety	1	1	1h30			22h30	02h30		100%
Transversal UE Code : UET 3.1 Crédits : 1 Coefficients : 1	Simulation Softwares	1	1	1h30			22h30	02h30		100%
Total semester 5		**30**	**17**	**12h00**	**6h00**	**7h30**	**382h300**	**367h30**		

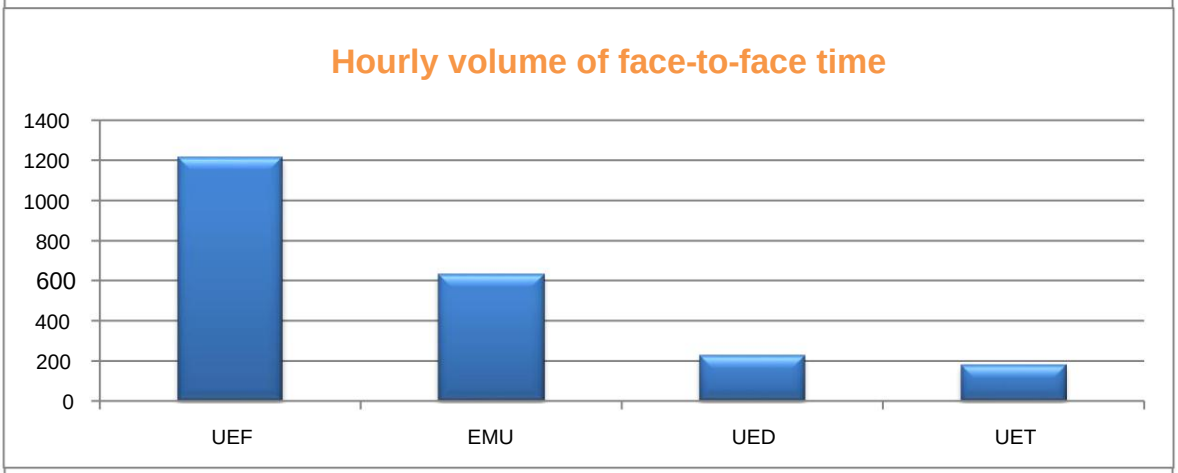
Semester 6

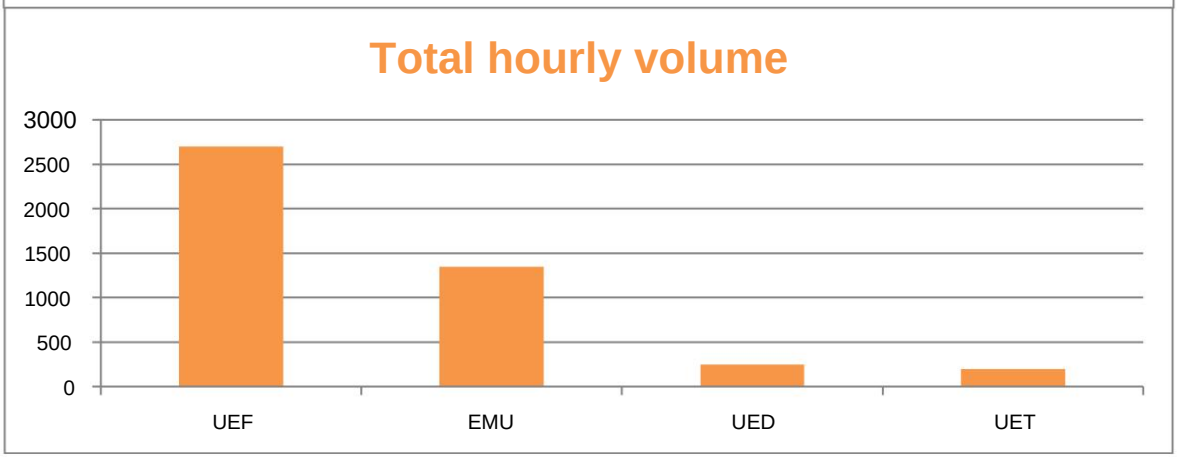
Teaching unit (UE)	Subjects Titled	Credits	Coefficient	Weekly hourly volume			Volume Hourly Biannual (15 Weeks)	Work Complementary In Consultation (15 weeks)	Assessment method	
				Cours	DW	PW			Control Continuous	Examen
Fondamental UE Code : UEF 3.2.1 Crédits : 10 Coefficients : 5	Sampled Servo Systems	4	2	1h30	1h30		45h00	55h00	40%	60%
	Actuators	4	2	1h30	1h30		45h00	55h00	40%	60%
	Sensors and chains of measure	2	1	1h30			22h30	27h30		100%
Fondamental UE Code : UEF 3.2.2 Crédits : 8 Coefficients : 4	Industrial programmable logic controllers	6	3	1h30	3h00		67h30	82h30	40%	60%
	Communication bus and Industrial networks	2	1	1h30			22h30	27h30		100%
Mthodological UE Code : UEM 3.2 Crédits : 9 Coefficients : 5	End of Cycle Project	4	2			3h00	45h00	55h00	100%	
	Sensors and Actuators PW	2	1			1h30	22h30	27h30	100%	
	Automats Industrial programmable PW	2	1			1h30	22h30	27h30	100%	
	Communication bus and Industrial networks PW	1	1			1h30	22h30	2h30	100%	
Discovery UE Code : UED 3.2 Crédits : 2 Coefficients : 2	Automatic electrical installations	1	1	1h30			22h30	02h30		100%
	Maintenance and reliability	1	1	1h30			22h30	02h30		100%
Transversal UE Code : UET 3.2 Crédits : 1 Coefficients : 1	Entrepreneur ship and start-ups	1	1	1h30			22h30	02h30		100%
Total semester 6		**30**	**17**	**12h00**	**6h00**	**7h30**	**382h300**	**367h30**		

Overall training summary:

EU / VH	UEF	EMU	UED	UET	Total
Course	720h00	120h00	225h00	6:00 p.m.	1245h00
TD	495h00	10:30 p.m.	---	---	5:17 p.m.
TP	---	487h30	---	---	487h30
Personal work	1485h00	720h00	25h00	8:00 p.m.	2250h00
Other (specify)	---	---	---	---	---
Total	2700h00	1350h00	250h00	8:00 p.m.	4500h00
Credits	108	54	10	8	180
% in credits for each EU	60%	30%	10%		100%







III - Detailed program by subject

Material Information Sheet

Semester: 1

Teaching unit: UEF 1.1.1

Subject 3: Analysis 1

VHS: 67h30 (Lecture: 1h30, Tutorial: 3h00)

Credits: 6

Coefficient: 3

Prerequisites:
Basic concepts of mathematics for final year classes (sets, functions, equations, etc.).

Teaching objectives
This first subject of Analysis I is particularly dedicated to the homogenization of students' knowledge upon entering university. The first new elements are taught progressively 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.

Content of the material:

Chapter 1: Properties of the set R

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

Chapter 2: Real Number Sequences

1. Convergent sequences.
2. Comparison theorems.
3. Monotone convergence theorem.
4. Extracted suites.
5. Adjacent suites.
6. Special sequences (arithmetic, geometric, recurring)

Chapter 3: Real functions with a single variable

1. Limits 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 formula 3. Limited
expansion of functions

Chapter 5: Simple Integrals

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

Assessment method:

CC: 40%, Final exam: 60%

Bibliographic references:

1- K. Allab, Elements of analysis, Function of a real variable, 1st & 2nd years of university, Office of University Publications.

2- J. Rivaud, Algebra: Preparatory Classes and University Volume 1, Exercises with Solutions, Vuibert.

3- N. Faddeev, I. Sominski, Collection of exercises in higher algebra, Moscow Edition

Semester: 1

Teaching unit: UEF 1.1.2

Subject 3: Algebra 1

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Prerequisites:

Basic concepts of mathematics for final year classes (sets, functions, equations, etc.).

Teaching objectives

This first subject of Algebra I is particularly dedicated to homogenizing the knowledge of students entering university. The first new elements are taught progressively 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.

Content of the material:

Chapter 1. Sets, Relations and Applications 1. Set Theory. **(5 weeks)**

2. Order relation, Equivalence relations.
3. Injective, surjective, bijective application and reciprocal function: definition of an application, direct image, reciprocal image, characteristic of an application.

Chapter 2: Complex Numbers 1. **(5 weeks)**

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 $+ = 0$, nth roots of a complex number.

Chapter 3: Vector Space (5 weeks)

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

Assessment method:

CC: 40%, Final exam: 60%

Bibliographic references:

1. J. Rivaud, Algebra: Preparatory Classes and University Volume 1, Exercises with Solutions, Vuibert.
2. N. Faddeev, I. Sominski, Collection of exercises in higher algebra, Moscow edition
3. M. Balabne, M. Duflo, M. Frish, D. Guegan, Geometry – 2e first cycle year classes preparatory, Vuibert University.
4. B. Calvo, J. Doyen, A. Calvo, F. Boshet, Algebra exercises, 1st scientific cycle preparation for the grandes écoles 2nd year, Armand Colin – Collection U.

Semester: 1

Teaching unit: UEF 1.1.3

Material: Mechanical element

VHS: 67h30 (Lecture: 1h30, Tutorial: 3h00)
Credits: 6

Coefficient: 3

Prerequisites:

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

Goals :

The teaching of this subject allows the student to acquire the fundamental notions of classical mechanics linked to the material point through:

- kinematics
- the dynamics
- and the concepts of work and energy.

Subject content: Physics 1 (Mechanics)

Chapter I: Reminder

- Dimensional analysis
- Vector analysis

Chapter II: Kinematics

- Concept of Reference
- Study of movements in space (general case, circular, rectilinear, intrinsic coordinates)
- Coordinate systems (Cartesian, polar, cylindrical, spherical)
- Relative motion (laws of composition of speeds and accelerations)

Chapter III: Dynamics

- Principle of inertia, inertial mass and Galilean frame of reference
- Momentum – Principle of conservation of momentum
- Concept of Force,
- Newton's Laws
- Differential equation of motion
- Different types of force (gravitational, elastic, viscous, etc.)

Chapter IV: Rotational Movement

- Angular Momentum, Moment of a Force
- Angular Momentum Theorem and Moment of Inertia
- Applications: torsion, pendulum, etc.

Chapter V: Work, power, energy

- Work and power of a force
- Kinetic energy
- Potential energy (gravitational, elastic, etc.) and equilibrium states.
- Conservative and non-conservative forces.
- Conservation of energy.
- Impulse and shocks (elastic and inelastic)

Assessment method:

CC: 40%, Final exam: 60

Semester: 1

Teaching unit: UEF 1.1.4

Subject 3: Structure of matter

VHS: 67h00 (Lecture: 1h30, Tutorial: 3h00)

Credits: 6

Coefficient: 3

Teaching objectives

Teaching this subject allows students to acquire basic chemistry formalisms, particularly in the subject describing the atom and chemical bonding, chemical elements and the periodic table with energy quantification. Making students better able to solve chemistry problems.

Recommended prior knowledge

Basic notions of mathematics and general chemistry.

Content of the material:

Chapter 1: Fundamental notions (2 Weeks)

States and macroscopic characteristics of the states of matter, changes of states of matter, notions of atom, molecule, mole and Avogadro's number, atomic mass unit, atomic and molecular molar mass, molar volume, Law of mass: Conservation of mass (Lavoisier), chemical reaction, Qualitative aspect of matter, Quantitative aspect of matter.

Chapter 2: Main constituents of matter Introduction: **(3 Weeks)**

Faraday's experiment: relationship between matter and electricity, Highlighting 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 electrons), Isotopy and relative abundance of different isotopes, Separation of isotopes and determination of the atomic mass and the average mass of an atom: Mass spectrometry: Bainbridge spectrograph, Binding and cohesion energy of nuclei, Stability of nuclei.

Chapter 3: Radioactivity – Nuclear Reactions (2 Weeks)

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

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

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

Chapter 5: Periodic Classification of Elements D. **(3 Weeks)**

Mendeleev's Periodic Classification, Modern Periodic Classification, Evolution and Periodicity of Physicochemical Properties of Elements, Calculation of Radii (Atomic and Ionic), Successive Ionization Energies, Electronic Affinity and Electronegativity (Mulliken Scale) by Slater's Rules.

Chapter 6: Chemical Bonds (Weeks) **(3**

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

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references 1.

Ouahes, Devallez, General Chemistry, OPU.
2. SS Zumdhal & coll., General Chemistry, De Boeck University.
3. Y. Jean, Electronic structure of molecules: 1 from the atom to simple molecules, 3rd edition, Dunod, 2003.

4. F. Vassaux, Chemistry in IUT and BTS.
5. A. Casalot & A. Durupthy, Inorganic Chemistry 2nd cycle course, Hachette.
6. P. Arnaud, Course in Physical Chemistry, Ed. Dunod.
7. M. Guymont, Structure of matter, Belin Coll., 2003.
8. G. Devore, General Chemistry: T1, study of structures, Coll. Vuibert, 1980.
9. M. Karapetiantz, Constitution of Matter, Ed. Mir, 1980.

Semester: 1

Teaching unit: UEM 1.1.1 Subject:

Practical work VHS mechanics element:

22H30 (practical work: 3h00)

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 linked 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
- Simple pendulum
- Swinging pendulum
- Solid-solid friction

Assessment method:

Continuous assessment: 100%;

Semester: 1

Teaching unit: UEM 1.1.2

Subject 3: Practical work on the structure of matter

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives

Teaching this subject allows students to acquire basic chemistry formalisms, particularly in the subject describing the atom and chemical bonding, chemical elements and the periodic table with energy quantification. Making students better able to solve chemistry problems.

Recommended prior knowledge

Basic notions of mathematics and general chemistry.

Practical work "Structure of matter"

Practical work No. 1 : Preliminary practical work: Safety in the chemistry laboratory and description of equipment and glassware.

TP No. 2: Change of state of water: Transition from liquid state to solid state and from liquid state to vapor state.

TP No. 3: Determining the quantity of material.

TP No. 4: Determination of molecular mass.

TP No. 5: Calculation of uncertainties - Determination of the ionic radius

TP No. 6: Determination of partial molar volumes in a binary solution.

TP No. 7: Qualitative analysis of Cations (1st, 2nd, 3rd and 4th group).

TP No. 8: Qualitative analysis of Anions.

TP No. 9: Identification of metal ions by the flame method

TP No. 10: Separation and recrystallization of benzoic acid.

TP No. 11 : Construction and study of some compact structures.

TP No. 12: Study of ionic structures

Assessment method:

Continuous assessment: 100%;

Bibliographic references 1.

Ouahes, Devallez, General Chemistry, OPU.

2. SS Zumdhal & coll., General Chemistry, De Boeck University.

3. Y. Jean, Electronic structure of molecules: 1 from the atom to simple molecules, 3rd edition, Dunod, 2003.

4. F. Vassaux, Chemistry in IUT and BTS.

5. A. Casalot & A. Durupthy, Inorganic Chemistry 2nd cycle course, Hachette.

6. P. Arnaud, Course in Physical Chemistry, Ed. Dunod.

7. M. Guymont, Structure of matter, Belin Coll., 2003.

8. G. Devore, General Chemistry: T1, study of structures, Coll. Vuibert, 1980.

9. M. Karapetiantz, Constitution of Matter, Ed. Mir, 1980.

Semester: 1

Teaching unit: UEM 1.1.3

Subject 3: Computer Structure and Applications

VHS: 45h00 (Lecture: 1h30, Practical work: 1h30)

Credits: 2

Coefficient: 2

Objective and recommendations:

The objective of the subject is to enable students to learn to program using a high-level language (Fortran, Pascal, or C). The choice of language is left to the discretion of each institution. The concept of algorithms must be implicitly addressed during language learning.

Recommended prior knowledge

Basic concepts of web technology.

Content of the material:

Part 1. **Introduction to Computer Science** 1- Definition of Computer Science **(5 Weeks)**

2- Evolution of computing and computers

3- Information coding systems

4- Operating principle of a computer

5- Hardware part of a computer

6- System part

Basic systems (operating systems (Windows, Linux, Mac OS, etc.)

Programming languages, application software

Part 2. **Concepts of algorithm and program** 1- Concept of an algorithm **(10 Weeks)**

2- Organizational chart representation

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- Input/output operations

8- Control structures: Conditional control structures, Repetitive control structures

Computer Science 1:

The practical exercises are intended to illustrate the concepts taught during the course. These exercises should begin with the lessons according to the following schedule:

• Introductory and familiarization work with the computer machine from a hardware and operating system point of view (exploration of the different functionalities of the OS)

• Introductory practical work on using a programming environment (Editing, Assembly, Compilation, etc.)

• Practical work on applying programming techniques seen in class.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references 1- John Paul Mueller and Luca Massaron, Algorithms for Dummies large format, 2017.

2- Charles E. Leiserson, Clifford Stein and Thomas H. Cormen, Algorithmics: course with 957 exercises and 158 problems, 2017.

3- Thomas H. Cormen, Algorithms: Basic Notions, 2013.

Semester: 1

Teaching unit: UET 1.1.1

Subject: Ethical and deontological dimension (the foundations)

VHS: 10:30 p.m. (Class: 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 develop students' awareness of ethical principles. It introduces them to the rules that govern life at university (their rights and obligations towards the university community) and in the world of work, raises awareness of respect for and the valorization of intellectual property, and explains the risks of moral evils such as corruption and how to combat them.

Recommended prior knowledge:

None

Content of the material:

I. Fundamentals – ÿÿÿÿÿÿ ÿÿÿÿÿ) 2 weeks)

Definitions:

1. Moral:
2. Ethics:
3. Ethics “Theory of Duty”:
4. The right:
5. Distinction between the different concepts
   - A. Distinction between ethics and morality
   - B. Distinction between ethics and deontology

II. The Reference Materials – 2 weeks)

Philosophical references

The religious reference

The evolution of civilizations

The institutional reference

III. The University Franchise – ÿÿÿÿÿÿÿ ÿÿÿÿÿ) 3 weeks)

The Concept of University Franchises

Regulatory Texts

University franchise fees University campus

stakeholders

IV. University Values – ÿÿÿÿÿÿÿÿ ÿÿÿÿÿ) 2 weeks)

Social Values

Community Values

Professional Values

V. Rights and Duties **(2 weeks)**

Student Rights
Student's duties
Teachers' Rights
Obligations of the professor-researcher
Obligations of administrative and technical staff

VI. University Relations **(2 weeks)**

Definition of the concept of university relations
Student-teacher relations
Student-student relations
Student-Staff Relations
Student Relations – Association Members

VII. Practices **(2 weeks)**

Best practices for the teacher
Best practices for the student

Assessment method:

Review: 100%.

Bibliographic references

1. Collection of ethics and professional conduct courses from Algerian universities.
2. BARBERI (J.-F.), 'Morality and corporate law', *Les Petites Affiches,* no. 68, June 7, 1995.
3. J. Russ, *Contemporary Ethical Thought,* Paris, puf, *Que sais-je?,* 1995.
4. LEGAULT, GA, Professionalism and Ethical Deliberation, Quebec, University Press of Quebec, 2003.
5. SIROUX, D., 'Ethics', in M. Canto-Sperber (ed.), Dictionary of Ethics and Moral Philosophy, Paris, Quadrige, 2004.
6. Prairat, E. (2009). Teaching professions in the era of ethics. *Education and Companies, 23.*
7. https://elearning.univ-annaba.dz/pluginfile.php/39773/mod_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ontology.pdf .

Semester: 1

Teaching unit: UED 1.1.1

Subject 3: Careers in science and technology

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 1

Coefficient: 1

Prerequisites: **Nothing**

Goals :

To introduce the student, in a first step, to all the sectors covered by the Science and Technology Field and in a second step to a range of careers that these sectors lead to. In the same context, this subject introduces the new challenges of sustainable development as well as the new careers that can result from it.

Content of the subject:

1. What are engineering sciences?

The engineering profession, history and challenges of the 21st century, Search for a profession/recruitment advertisement by keyword, develop a simple job description (job title, company, main activities, skills required (knowledge, know-how, interpersonal skills)

2. Electronics, Telecommunications, Biomedical Engineering, Electrotechnics, Electromechanics, Optics & Precision Mechanics sectors:

- Definitions, areas of application (Home automation, on-board applications for automobiles, Video surveillance, Mobile telephony, Optical fiber, Advanced scientific instrumentation, Imaging and medical instrumentation, Giant mirrors, Contact lenses, Transport and distribution of electrical energy, Power generation plants, Energy efficiency, Maintenance of industrial equipment, Elevators, Wind turbines, etc.)

- Role of the specialist in these areas.

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

4.Process Engineering, Hydrocarbons and Petrochemical Industries:

- Definitions, Pharmaceutical industry, Food industry, Leather and textile industry, Biotechnologies, Chemical and petrochemical industry, Plastics industry, Energy sector (oil, gas),
…
- Role of the specialist in these areas.

1. Industrial Hygiene and Safety (IHS) and Mining Engineering sectors : -

Definitions and areas of application (Safety of property and people, Environmental problems, Exploration and exploitation of mining resources, etc.)
- Role of the specialist in these areas.

2. Climate Engineering and Transport Engineering - Definitions, areas of application (Air Conditioning, Smart Buildings, Transport Safety, Traffic Management and Road, Air, Naval Transport, etc.)

- Role of the specialist in these areas.

3. Civil Engineering, Hydraulics and Public Works courses: (2 weeks)

- Definitions and areas of application (Construction materials, Major road infrastructures and

railways, bridges, airports, dams, drinking water supply and sanitation, hydraulic flows, water resource management, public works and land use planning, smart cities, etc.)

- Role of the specialist in these areas.

4. Aeronautics, Mechanical Engineering, Maritime Engineering and Metallurgy sectors:
- Definitions and fields of application (Aeronautics, Avionics, Automotive industry, Ports, Dikes, Production of industrial equipment, Steel industry, Metal transformation, etc.)
- Role of the specialist in these areas.

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

Student's personal work for this subject:
The teacher in charge of this subject can let his students know that he can always assess them by asking them to prepare job descriptions. Ask students to watch a popular science film at home related to the chosen job (after giving them either the film electronically or giving them the internet link to this film) and then ask them to submit a written report or make an oral presentation of the summary of this film, etc. The bonus for these activities is left to the discretion of the teacher and the training team who alone are able to define the best way to take this personal work into account in the overall grade of the final exam.

Assessment method:
Review: 100%.

Bibliographic references:

[1] What jobs for tomorrow? Publisher: ONISEP, 2016, Collection: Les Dossiers.
[2] J. Douënel and I. Sédès, Choosing a job according to your profile, Editions d'Organisation, Collection: Jobs & Careers, 2010.
[3] V. Bertereau and E. Ratière, What job are you made for? Publisher: L'Étudiant, 6th edition, Collection: Métiers, 2015.
[4] The great book of professions, Publisher: L'Étudiant, Collection: Métiers, 2017.
[5] Careers in the aeronautics and space industry, Collection: Parcours, Edition: ONISEP, 2017.
[6] Careers in electronics and robotics, Collection: Parcours, Edition: ONISEP, 2015.
[7] Construction and public works trades, Collection: Parcours, Edition: ONISEP, 2016.
[8] Transport and logistics professions, Collection: Parcours, Edition: ONISEP, 2016.
[9] Energy professions, Collection: Parcours, Edition: ONISEP, 2016.
[10] Mechanical professions, Collection: Parcours, Edition: ONISEP, 2014.
[11] Chemistry professions, Collection: Parcours, Edition: ONISEP, 2017.
[12] 12- Web professions, Collection: Parcours, Edition: ONISEP, 2015.

Semester: 2

Teaching unit: UEF 1.2.1 Subject:

Analysis 2 VHS:

67h30 (Lecture: 1h30, TD: 3h00)

Credits: 6

Coefficient: 3

Prerequisites:

It is recommended to master the fundamental bases of the calculation of integrals and primitives and of mathematics taught in S1

Goals :

Of prime importance for a scientist, this subject allows the student to acquire: • the methods of solving differential equations necessary for the problems encountered in engineering and physics • methods of calculating differentiability and integrals of multivariable functions (surface volumes), the different forms of limited development

Content of the subject:

Chapter 1: Ordinary Differential Equations

1. First-order ordinary differential equations 1.1 Historical note.

1.2 Physical model leading to a differential equation.
1.3 General definitions 1.4
General notions on first-order differential equations.
□□ General solution. Particular solution.
1.5 Equations with separate and separable variables.
1.6 First-order homogeneous equations. Definitions and examples.
□□ Solving the homogeneous equation.
1.7 Equations reducing to homogeneous equations.
□□ Solving the linear equation.
1.8 Bernoulli equation.
□□ Definition. Solving the Bernoulli equation.

2. Second-order differential equations 2.1
Historical note.
2.2 Homogeneous linear equations. Definitions and general properties.
2.3 Second-order homogeneous 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 Second-order non-homogeneous linear equations Method of variation of arbitrary constants.
2.6 Non-homogeneous second-order linear equations with constant coefficients Case where the second member 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: Case where the second member is of the
form a. if is not a root of the characteristic equation:

b. if is a root of the characteristic equation:

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

2.1 Historical note 2.2
Scope of definition.
2.3 Notion of limit.

Introduction. Concept of neighborhood. Definition of the limit of a function of two variables. Do not confuse limit along a direction with limit.
2.4 Continuity of functions of two variables.

2.5 Partial derivatives of order one.
Definition of partial derivatives of order one of a function of 2 variables at a point (xÿ,yÿ)

The partial derivative function. Second-order partial derivatives. Continuity and existence of the partial derivatives ((ÿf)/(ÿx)) and ((ÿf)/(ÿy))
2.6 Differentiable functions.
Introduction. Definition of differentiable functions. Case of functions of a real variable f:ÿÿÿ.

Definition of differentiable functions. Case of functions of two variables f:ÿ²ÿÿ

Relationship between differentiable function and existence of partial derivatives ((ÿf)/(ÿx)) and ((ÿf)/(ÿy)).
Relationship between differentiability and continuity.
2.7 Concept of differential of a function of two variables.

2.8 Partial derivatives of composite functions.
Partial derivatives of composite functions of type 1. Derivatives of composite functions of type 2.

2.9 Taylor formula for functions of 2 variables.
Partial derivatives of order n, n>2.
2.10 Differentiable optimization in ÿ².
Definitions of local and global optimum. Necessary conditions for optimality. Sufficient conditions for optimality.

Chapter 3

1. Double Integrals 1.1
Definition of the double integral 1.2
Examples 1.3
Properties of the double integral • Linearity,
• Conservation
of order, • Additivity.

1.4 Fubini's theorem in the case of a bounded domain ÿ .

1.5 Calculation of double integrals •
Direct calculation, •
Change of variables in a double integral (Formula for change of variables).
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 Calculation of a triple integral •

Direct calculation •

Calculation by change of variables (Formula for change of 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.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references: [1]

KadaAllab, Elements of Analysis. Office of University Publications. Ben Aknoun. Algiers 1984 **[2] N. Piskounov,** Differential and

Integral Calculus. Mir Editions. Moscow 1978 **[3] J. Dixmier,** First Cycle Mathematics Course.

1st year. Gauthiers-Villars. Paris 1976 **[4] R. Murray Spiegel.** Theory and Applications of Analysis. McGraw-Hill, Paris 1973 **[5] G.**

Flory, Topology, Analysis. Exercises with solutions. Vuibert. Paris 1978

Semester: 2

Teaching unit: UEF 1.2.2 Subject: Algebra

2 VHS: 45h00 (Lecture:

1h30, TD: 1h30)

Credits: 4

Coefficient: 2

Prerequisites:

- Algebra 1

Objectives: -

Consolidate the knowledge acquired in the first semester.

- Study new concepts: sum of several vector subspaces, stable subspaces, trace.

- Switch from geometric register to matrix register and vice versa.

Teaching content:

Chapter 1: Vector Spaces ÿ Definition (on ÿ and ÿ). ÿ Vector subspaces. ÿ Sum of subspaces. ÿ Supplementary subspaces. ÿ Free family. Bound family. (Finite) basis.

Chapter 2: Linear Applications ÿ Definition (operations). ÿ Kernel and image. ÿ Rank of a linear application. ÿ Rank theorem. ÿ Characterization of injection, surjection and bijection.

Chapter 3: Matrices, associated matrices and determinants

ÿ Definition (as a table of numbers). Particular matrices. ÿ Operations on matrices. The vector space of matrices. ÿ Determinants (definition (order 2, 3 and generalization) and properties). ÿ Invertible matrix. ÿ Matrix writing of a linear application. ÿ Correspondence between operations on linear applications and those on matrices.

ÿ Change of basis matrix (transition matrix). ÿ Effect of a change of basis on the matrix of a linear application.

Chapter 4: Systems of linear equations ÿ Definitions and interpretations.

ÿ Cramer systems (general case).

Chapter 5: Matrix Reduction. ÿ Eigenvalues.

ÿ Eigenvectors.

ÿ Characteristic polynomials. Cayley-Hamilton theorem.

ÿ Characterization of diagonalizable matrices.

ÿ Characterization of trigonalizable matrices. ÿ Applications of reduction.

Bibliographic references:

ÿ A.KUROSH: Course in higher algebra. Edition MIR MOSCOW.

ÿ D.FADEEV and I.SOMINSKY: Collection of exercises in higher algebra. MIR MOSCOW Edition.

ÿ J.RIVAUD: Exercises with solutions volume 1 VUIBERT.

ÿ J.RIVAUD: Exercises with solutions volume 2 VUIBERT.

ÿ LEBSIR HABIB: General algebra tutorials. Dar el-houda Ain M'LILA. ÿ Jean-Pierre Escofier: All the algebra for the bachelor's degree. Courses and corrected exercises. Dunod.

ÿ J.Lelong-Ferrand, JMArnaudiès: Mathematics Course. Volume 1 Algebra 3 2nd edition. Preparatory classes for undergraduate university studies. Dunod.

ÿ A.DONEDDU: ALGEBRA AND GEOMETRY 7 Special Mathematics First university cycle. VUIBERT.

ÿ COLLET Valérie: MATHS All second year. ellipses

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Semester: 2

Teaching unit: UEF 1.2.3

Matter Electricity and Magnetism

VHS: 67h30 (Lecture: 1h30 – Tutorial 3h00)

Credits: 6

Coefficient: 3

Prerequisites:

- ÿ Concepts of vector field and scalar field.
- ÿ Concepts of vector calculus.
- ÿ Electrical charges.

Objectives:

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

Content of the subject:

Chapter 1: Electrostatic Field and Potential ÿ Point Charge. ÿ Electric Force and Coulomb's Law. ÿ Electric Field and Potential (Discontinuous Charge Distribution). ÿ Electric Dipole: Electric Field and Potential. ÿ Action of the Electric Field on a Dipole (Orientation and Equilibrium State). ÿ Electric Field and Potential (Continuous Charge Distribution). ÿ Gauss's Theorem.

Chapter 2: Conductors ÿ Basic properties. ÿ Induced charge and influencing phenomena ÿ Electrostatic pressure. ÿ Capacitors, capacity (different types), stored energy.

Chapter 3: Electric current ÿ Concepts of intensity and current density. ÿ Resistance and Ohm's law, Joule's law.

Chapter 4: Magnetostatics ÿ Introduction. ÿ Magnetic force and Lorentz's law. ÿ Action of a magnetic field on an electric current. ÿ Magnetic field produced by a stationary current: Biot-Savart's law. ÿ Circulation of the magnetic field. ÿ Rotation of the magnetic field and Ampère's law.

ÿ Magnetic field flux through a closed loop and induction. ÿ Maxwell's equations.

Bibliographic references: Physics,

2. Electricity and magnetism, Harris Benson, de Boeck editions. Physics, 2. Electricity and magnetism, Eugene Hecht, de Boeck editions. General Physics, Electricity and magnetism, Douglas Giancoli, de Boeck editions

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Semester: 2

Teaching unit: UEF 1.2.4

Subject: Thermodynamics

VHS: 67h30 (Lecture: 1h30, Tutorial: 3h00)

Credits: 6

Coefficient: 3

Goals :

The knowledge acquired allows the characterization of the behavior of liquid, solid and gaseous substances and the evaluation of their thermodynamic properties for different conditions (temperature, pressure, simple pure bodies, ideal mixture and phase change)

Content of the material

Chapter I : **Basic concepts in 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
Behavior of Gases II.3
Corresponding States and Residual Differences
II.4 Properties of Liquids and Solids

Chapter **III: Fundamental Concepts of Thermodynamics** II.1 First
Law and Applications II.2 Entropy and
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: Equilibria of physical processes** IV.1
Phase equilibria of a pure substance
IV.2 Thermodynamic properties of phase transitions IV.3 Ideal
behavior of gaseous, liquid and solid mixtures
IV.4 Phase equilibria of a compound in an ideal mixture IV.5
Ideal solubility and partition coefficient

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references: [1]

Smith, EB, Basic Chemical Thermodynamics, 2nd ed., Clarendon Press, Oxford, 1977.
[2] Rossini, FD, Chemical Thermodynamics, Wiley, New York, 1950. Florence, [3]
Stanley I. Sandler, Chemical and Engineering Thermodynamics, Wiley, New York, 1977.
[4] Elliot, J, Lira CT, Introductory chemical engineering Thermodynamics, Prentice–Hall (1999)
[5] Lewis GN, Randal M., Thermodynamics, Mac Graw Hill [6]
Hougen OA, Watson KM, Chemical process principles, Vol II: thermodynamics John Wiley and sons

Semester: 2

Teaching unit: UEM 1.2.1 Subject 1:

Practical work on Electricity and Magnetism VHS:

45 hours (practical work: 1.5 hours)

Credits: 2

Coefficient: 1

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

Recommended prior knowledge: Mathematics 1, Physics 1.

Content of the material:

5 manipulations minimum **(3h00 / 15 days)**

- Presentation of measuring instruments and tools (Voltmeter, Ammeter, Rheostat, Oscilloscopes, Generator, etc.).

- Kirchhoff's laws (mesh law, knot law).
- Thévenin's theorem.
- Association and measurement of inductances and capacities - Charging and discharging a capacitor -
Oscilloscope - Practical work on magnetism

Assessment method:

Continuous assessment: 100%

Semester: 2

Teaching unit: UEM 1.2.2 Subject:

Thermodynamics practical work VHS:

10:30 p.m. (practical work: 3:00 a.m.)

Credits: 2

Coefficient: 1

Prerequisites:

Nothing

Goals :

The knowledge acquired allows the characterization of the behavior of liquid, solid and gaseous substances and the evaluation of their thermodynamic properties for different conditions (temperature, pressure, simple pure bodies, ideal mixture and phase change)

Practical work in Thermodynamics:

Practical work No. 1: Study of the equation of state of an ideal gas.

TP No. 2: Water value of the calorimeter.

TP No. 3: Specific heat: specific heat of liquid and solid bodies.

TP No. 4: Study of the solidification of pure water.

TP No. 5: Latent heat: Latent heat of fusion of ice.

TP No. 6 : Determination of the latent heat of vaporization.

TP No. 7: Heat of reaction: Determination of the energy released by a chemical reaction (HCl/NaOH).

TP No. 8: Thermodynamic functions of an Acid-Base equilibrium.

TP No. 9: Study of the variation of pressure as a function of temperature at equilibrium (lg) for a pure system: water.

TP No. 10: Vapor pressure of a solution.

TP No. 11: Equilibrium diagram for a binary system.

TP No. 12: Equilibrium diagram for a ternary system.

Assessment method:

Continuous assessment: 100%;

Semester: 2

Teaching unit: UEM 1.2.3

Subject 3: Introduction to programming

VHS: 45h00 (Lecture: 1h30, Practical work: 1h30)

Credits: 2

Coefficient: 2

Teaching objectives

- Acquire the fundamental bases in 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 language
- Acquire good programming and code documentation practices

Recommended prior knowledge

- No prior programming experience is required
- Basic notions of mathematics (final year level)
- Basic computer skills
- Basic knowledge of an operating system

Content of the subject:

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

- History of programming languages, Concept of algorithm and programming, The process of developing a program, Presentation of 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/Outputs and Expressions (2 Weeks)

- Using the printf() and scanf() functions, Data formatting, Expressions and order evaluationm Type conversions

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

- if-else statementsm Comparison operatorsm Logical operatorsm Switch-case structurem While and do-while loopsm Loop form Nesting loopsm Break and continue statements

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

- Definition and declaration of functionsm Passing parametersm Return valuesm Recursive functions, Declaration and use of arraysm Multidimensional arraysm Strings in Cm Standard functions for strings

Chapter 6: Pointers and Dynamic Allocation (2 Weeks)

- Memory address conceptm Operators & and *m Memory allocation and releasem Relationship between arrays and pointers

Chapter 7: Structures and Enumerations (2 Weeks)

- Definition of structured typesm Access to membersm Arrays of structuresm Enumerations

Detailed content of the practical sessions

TP 1: Understanding the environment

- Installing the IDE (Code::Blocks, Visual Studio Code with C extensions)
- First program "Hello World"
- Compilation and execution
- Correction of simple errors

TP 2: Variables and expressions

- Declaration and initialization of variables
- Arithmetic operators
- Simple calculations and display of results

TP 3: Conditional structures and iterative structures

- Implementing programs with if-else
- Using switch-case
- Comparison and logical operators
- Implementation of while, do-while and for loops
- Creation of counters and accumulators
- User input validation

TP 4: Functions

- Creation and calling of functions
- Passing parameters by value
- Organization of the code according to functions

TP 5: One-dimensional and multidimensional arrays

- Table manipulation
- Search and sort (simple algorithms)
- Passing from tables to functions
- Creation and manipulation of matrices
- Operations on matrices

TP 6: Character strings -

Manipulating strings with the functions of the string.h library - Word processing

TP 7: Pointers and dynamic allocation

- Use of pointers
- Memory allocation and release
- Dynamic tables

TP 8: Files

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. Kernighan, B.W., & Ritchie, D.M. (2022). *The C language: ANSI standard,* 2nd edition. Dunod.
2. Perry, G. (2007). Corrected exercises on the C language, 2nd edition. Dunod.
3. Delannoy, C. (2016). *Programming in C: Course and Corrected Exercises,* 5 4. Tanenbaum, A.S. eme edition. Eyrolles.
(2008). Operating Systems With More Than 400 Exercises, 3rd Edition. Pearson.
5. *Yves,* M. (2009). C in action Solutions and examples for C programmers, 2 e edition, ENI, ISBN10: 2746052563.
6. Online Resources: - *Learn C Programming* at https://www.learn-c.org/ - *C Programming* at https://www.tutorialspoint.com/cprogramming/

Semester: 2

Teaching unit: UET 1.2 Subject 1: Free and Open Source Software VHS: 45h00 (Lecture: 1h30 & Workshop: 1h30)
Credits: 2
Coefficient: 2

Course Objectives: This course 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. Upon completion of this course, 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 subject:

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

Chapter 2: Legal framework and licenses (2 weeks)
- Introduction to copyright as applied to software
- Main free licenses: GPL, LGPL, BSD, MIT, Apache
- Compatibility between licenses
- Implications for Algerian educational institutions and businesses

Chapter 3: Free Operating Systems (3 weeks)
- Introduction to GNU/Linux
- Presentation of distributions adapted to the educational context
- Installation principles and basic configuration
- Basic commands and package management

Chapter 4: Free Office Solutions (3 weeks)
- LibreOffice as an alternative to Microsoft Office
  - ÿ Writer (word processor) ÿ Calc (spreadsheet) ÿ 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: Perspectives and future of free software (2 weeks)
- Open source communities and contribution methods
- Economic models of free software
- Public policies and free software in Algeria
- Professional opportunities related to free software

Workshops

Atl. 1: Discovering Linux

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

Atl. 2: Software Management under Linux

- Using package managers
- Software installation and updating
- Configuration of software repositories

Atl. 3: Migration to LibreOffice - Installation and configuration of LibreOffice

- Creation and editing of documents with Writer
- Conversion of proprietary formats to open formats
- Creation of models adapted to the needs of the student **Atl. 4: Free spreadsheets and presentations** - Advanced use of Calc (formulas, graphics)
- 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
- Creation 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
- Creation of a simple website
- Basic security

Atl. 7: Collaborative Development - Using Git for Version Control

- Setting up a free development environment
- Participation in a collaborative mini-project
- Use of a software forge (GitHub, GitLab)

Assessment method: 100% exam

Bibliographic references:

1. Stallman, R. (2002). "Free as in Freedom: Richard Stallman's Crusade for Free Software", 1st Edition, O'Reilly Media.
2. Mathieu 3. , N. (2012). "Take Back Control with Linux - 2nd Edition". EYROLLES.
Stutz, M. (2001). "The Linux Cookbook: Tips and Techniques for Everyday". No StarchPress.
4. Collectif Eni. (2009). " Introduction to free software OpenOffice.org 3, Firefox 3 and Thunderbird". ENI Editions.
5. François, E. (2009). "The Economics of Free Software". EYROLLES.
6. Marie, C. (2014). " Free Software for the Maghreb? From Theoretical Opportunities to Empirical Realities . Institute for Research on the Contemporary Maghreb.
1. GNU Project Documentation: 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

Teaching unit: UEF 2.1.1 Subject:

Analysis 3 VHS: 67h30

(Lecture: 1h30, TD: 3h00)

Credits: 6

Coefficient: 3

Prerequisites:

It is recommended to master the fundamental bases of the calculation of integrals and primitives of functions with several variables and the mathematics taught in S1 and S2

Goals :

Of prime 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 the resolution of equations and systems of differential equations

Content of the subject:

Chapter 1: Vector Analysis

1. Scalar Fields and Vector Fields Definition of a Scalar
Field Definition of 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. Curve integral 6. Calculation of the curve integral 7. Green's formula 8. Conditions for a curve integral not to depend on the integration path 9. Surface integrals 10. Calculation of surface integrals 11. Stockes' formula 12. Ostrogradsky's formulas

Chapter 2: Numerical and integer series

I- Numerical series 1.
General: Partial

sum. Convergence, divergence, sum and remainder of a convergent 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 Comparison Criterion Theorem

Consequence

(Equivalence Rule)

4.3 D'Alembert's rule - Theorem
4.4 Cauchy's

rule - Theorem 4.5
Cauchy's

integral criterion - Theorem 5. Series
with arbitrary

terms 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: CVAÿCVS 5.3
Semi-convergent series.

Definition of a semi-convergent series Examples 5.4

Abel's
Criterion Theorem

(Abel's first criterion for series)

II- Power series 1.

Definition of a power series, ABEL's

lemma, Radius of

convergence Determination

of the radius of convergence, HADAMARD's rule.

2. Properties of power series.

Linearity and product of two power series, Normal

convergence of an SE of a real variable under any segment included in the open interval of convergence,

Continuity of the sum on the open interval of

convergence, Term-by-term integration of an SE of a real variable on the interval

of convergence, Term-by-term derivation of an SE of a real variable on the interval of

convergence.

3. Development in SEau near zero of a function of a real variable.

Function developable in SE on the open interval of convergence.

Taylor-Maclaurin series of a function of class ÿ Uniqueness of the SE

development

4. Applications.

Establish the developments in power series of the usual functions

Finding the solution to a first and second order ordinary differential equation with variable coefficients in SE form

Chapter 3: Fourier Series

1. General definitions
2. Fourier coefficients.
3. Function developable in Fourier series.
4. Dirichlet's Theorem
5. Parseval 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
Derivative of the Fourier transform

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

Assessment methods:

Exam: 60% and CC: 40%

Bibliographic references:

1. Med El Amrani, Numerical suites and series, Ellipses.
2. François Liret; mathematics in practice, courses and exercises; Dunod. (fpv; Int. Mult. Series…)
3. Marc Louis, Maths MP-MP, Ellipses. (Int. Doubles)
4. Denis Leger, PSI. Corrected Math Exercises, Ellipses. (Function Series, Integers, Fourier, etc.)
5. Charles-Michel Marle, Philippe Pilibossian, Sylvie Guerre-Delabrière, Ellipse. (Sequences, Series, Integrals).
6. Fabrice Lembiez Nathan, All in one, Math exercises.
7. Valerie Collet, Maths throughout the second year, 361 exercises, course reminders, tips and tricks, ellipses.
8. A. Monsouri, MK Belbarki. Element of analysis. Course and solved exercises. 1st university cycle. Chiheb. (Double and triple integrals, Series, Fourier and Laplace transformations, Partial differential equations of the 2nd order).
9. B. DEMIDOVITCH. Collection of exercises and problems in mathematical analysis. 11th edition. Ellipses. (Functions of several variables, Series, Multiple integrals)

Semester: 3

Teaching unit: UEF 2.1.1
Subject 2: Waves and Vibrations

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4

Coefficient: 2

Teaching objectives

Introduce the student to the phenomena of mechanical vibrations restricted to low 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 subject:

Preamble : *This subject is divided into two parts, Waves and Vibrations, which can be approached independently of each other. In this regard, and due to the consistency of this subject in terms of content, it is recommended to approach this subject in this order: Waves and then Vibrations for students in the Electrical Engineering streams (Group A).*

While for students in Groups B and C (Civil Engineering, Mechanical Engineering and Process Engineering), it is advisable to start with Vibrations. In any case, the teacher is called upon to do his 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 skim over all parts of the course that require demonstrations or theoretical developments and to focus only on the applied aspects. Moreover, the demonstrations can be the subject of auxiliary work to be requested from the students as activities within the framework of the student's personal work. Consult in this regard the paragraph "G- Student Assessment through Continuous Assessment and Personal Work" present in this training offer.

Part A: Vibrations

Chapter 1: Introduction to Lagrange's equations 1.1 Lagrange's equations for a particle 1.1.1 Lagrange's equations 1.1.2 Case of conservative systems 1.1.3 Case of velocity-dependent friction forces 1.1.4 Case of a time-dependent external force 1.2 System with several degrees of freedom. **2 weeks**

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

Chapter 3: Forced Oscillations of One-Degree-of-Freedom Systems 3.1 Differential Equation 3.2 Mass-Spring-Damper System 3.3 Solution of the Differential Equation 3.3.1 Harmonic excitation 3.3.2 Periodic excitation 3.4 Mechanical impedance **1 week**

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-Degree-of-Freedom Systems 2 weeks 5.1 Lagrange Equations 5.2 Mass-Spring-Damper System 5.3 Impedance 5.4 Applications

5.5 Generalization to systems with n degrees of freedom

Part B: Waves

Chapter 1: One-dimensional propagation phenomena 1.1 Generalities and basic definitions 1.2 Propagation equation 1.3 Solution of the propagation equation 1.4 Progressive sinusoidal wave 1.5 Superposition of two progressive sinusoidal waves **2 weeks**

Chapter 2: Vibrating Strings 2.1 Wave Equation 2.2 Harmonic Progressive Waves 2.3 Free Oscillations of a String of Finite Length 2.4 Reflection and Transmission **2 weeks**

Chapter 3: Acoustic Waves in Fluids 3.1 Wave Equation 3.2 Speed of sound 3.3 Progressive sinusoidal wave 3.4 Reflection-Transmission **1 week**

Chapter 4: Electromagnetic Waves 4.1 Wave Equation 4.2 Reflection-Transmission 4.3 Different types of electromagnetic waves **2 weeks**

Assessment method:

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

Bibliographic references:

1. H. Djelouah; Vibrations and Mechanical Waves – Courses & Exercises (University of USTHB: perso.usthb.dz/~hdjelouah/Coursvom.html)
2. T. Becherrawy; Vibrations, waves and optics; Hermes science Lavoisier, 2010
3. J. Brac; Propagation of acoustic and elastic waves; Hermès science Publ. Lavoisier, 2003.
4. R. Lefort; Waves and Vibrations; Dunod, 2017
5. J. Bruneaux; Vibrations, waves; Ellipses, 2008.
6. J.-P. Perez, R. Carles, R. Fleckinger; Electromagnetism Foundations and Applications, Ed. Dunod, 2011.
7. H. Djelouah; Electromagnetism; Office of University Publications, 2011.

Semester: 3

Teaching unit: UEF 2.1.2

Subject 1: Fundamental Electronics 1

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

Explain the calculation, analysis, and interpretation of electronic circuits. Understand 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 subject:

The number of weeks displayed is for informational purposes only. It is clear that the course leader is not required to strictly adhere to this dimension 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, Maximum power transfer theorem.

Chapter 2. Passive Quadrupoles **3 weeks**

Representation of a passive network by a quadrupole. Quantities characterizing the behavior of a quadrupole in an assembly (input and output impedance, voltage and current gain), application to matching. Passive filters (low-pass, high-pass, etc.), Gain curve, Phase curve, Cutoff frequency, Bandwidth.

Chapter 3. Diodes **3 weeks**

Basic reminders on the physics of semiconductors: Definition of a semiconductor, Crystalline Si, Doping concepts, N and P semiconductors, PN junction, Construction and operation of a diode, direct and reverse polarizations, Current-voltage characteristic, static and variable regime, Equivalent diagram. Applications of diodes: Single and double half-wave rectification.

Voltage stabilization by Zener diode. Clipping, Other types of diodes: Varicap, LED, Photodiode.

Chapter 4. Bipolar Transistors **3 weeks**

Bipolar Transistors: Transistor effect, operating modes (blocking, saturation, etc.), Static characteristics network, Polarizations, Load line, Quiescent point, etc. Study of the three fundamental assemblies: EC, BC, CC, Equivalent diagram, Voltage gain, Decibel gain, Bandwidth, Current gain, Input and output impedances. Study of multi-stage BF amplifiers in static and dynamic conditions, link capacitors, decoupling capacitors. Other uses of the transistor: Darlington assembly, switching transistor, etc.

Chapter 5- Operational amplifiers: Principle, **3 weeks**

Equivalent diagram, Ideal op-amp, Feedback, Characteristics of the op-amp, Basic assemblies of the operational amplifier: Inverter, Non-inverter, Adder, Subtractor, Comparator, Follower, Differentiator, Integrator, Logarithmic, Exponential, etc.

Assessment method:

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

Bibliographic references:

1. A. Malvino, Principle of Electronics, 6th Edition Dunod, 2002.
2. T. Floyd, Electronic Components and Application Systems, 5th Edition, Dunod, 2000.
3. F. Milsant, Electronics Course (and Problems), Volumes 1 to 5, Eyrolles.
4. M. Kaufman, Electronics: Components, Volume 1, McGraw-Hill, 1982.
5. P. Horowitz, Treatise on Analog and Digital Electronics, Volumes 1 and 2, Publitronic-Elektor, 1996.
6. M. Ouhrouche, Electrical Circuits, International Polytechnic Press, 2009.
7. Neffati, General Electricity, Dunod, 2004 8. D. Dixneuf, Principles of Electrical Circuits, Dunod, 2007 9. Y. Hamada, Electronic Circuits, OPU, 1993.
10. I. Jelinski, All Electronics in Exercises, Vuibert, 2000.

Semester: 3

Teaching unit: UEF 2.1.2

Subject 2: Fundamental electrical engineering 1

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives :

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

Recommended prior knowledge: Basic electricity concepts.

Content of the subject:

Chapter 1. Mathematical reminders on complex numbers (CN) (1 week)

Cartesian form, conjugate NCs, Module, Arithmetic operations on NCs (addition, etc.), Geometric representation, Trigonometric form, Moivre formula, root of NCs, Representation by an exponential of an NC, Trigonometric application of Euler's formulas, Application to electricity of NCs.

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

Continuous regime: electric dipole, association of R, C, L dipoles.
Harmonic regime: representation of sinusoidal quantities, average and effective values, Fresnel representation, complex notation, impedances, powers in sinusoidal regime (instantaneous, active, apparent, reactive), Boucherot's Theorem.
Transient regime: RL circuit, RC circuit, RLC circuit, charging and discharging of a capacitor.

Chapter 3. Electrical Circuits and Powers (3 Weeks)

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

Chapter 4. Magnetic Circuits (3 Weeks)

Magnetic circuits in sinusoidal alternating current. Self and mutual inductance. Electrical-magnetic analogy.

Chapter 5. Transformers (3 Weeks)

Ideal single-phase transformer. Real single-phase transformer. Other transformers (isolation, pulse, autotransformer, three-phase transformers).

Chapter 6. Introduction to Electrical Machines (3 Weeks)

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

Assessment method:

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

Bibliographic references:

(Depending on the availability of documentation at the establishment level, websites, etc.)

1. JP Perez, Electromagnetism Foundations and Applications, 3rd Edition, 1997.
2. A. Fouillé, Electrotechnics for Engineers, 10th edition, Dunod, 1980.
3. C. François, Electrical Engineering, Ellipses, 2004

4. L. Lasne, Electrotechnique, Dunod, 2008
5. J. Edminister, Theory and applications of electrical circuits, McGraw Hill, 1972 6. D. Hong, Electrical circuits and measurements, Dunod, 2009
7. M. Kostenko, Electrical Machines - Volume 1, Volume 2, Editions MIR, Moscow, 1979.
8. M. Jufer, Electromechanics, Polytechnic and University Presses of Romandie - Lausanne, 2004.
9. A. Fitzgerald, Electric Machinery, McGraw-Hill Higher Education, 2003.
10.J. Lesenne, Introduction to Advanced Electrical Engineering. Technique and Documentation, 1981.
11.P. Maye, Industrial electric motors, Dunod, 2005.
12. S. Nassar, Electric Circuits, Maxi Schaum.

Semester: 3

Teaching unit: UEM2.1

Subject 1: Probability and Statistics

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Subject objectives

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

Recommended prior knowledge

Mathematics 1 and Mathematics 2

Content of the material:

Part A: Statistics

Chapter 1: Basic definitions A.1.1 **(1 week)**

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

Chapter 2: Single-variable statistical series A.2.1 **(3 weeks)**

Number, Frequency, Percentage.

A.2.2 Cumulative workforce, Cumulative frequency.

A.2.3 Graphical representations: bar chart, pie chart, stick 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-variable statistical series A.3.1 Data **(3 weeks)**

tables (contingency table). Scatter plot.

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: Probabilities

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

B.1.1 Arrangements

B.1.2 Combinations

B.1.3 Permutations.

Chapter 2: Introduction to Probability B.2.1 **(2 weeks)**

Algebra of Events

B.2.2 Definitions

B.2.3 Probability spaces

B.2.4 General probability theorems

Chapter 3: Conditioning and Independence B.3.1 **(1 week)**

Conditioning,

B.3.2 Independence,

B.3.3 Bayes formula.

Chapter 4: Random Variables B.4.1 **(1 Week)**
Definitions and Properties, B.4.2
Distribution Function, B.4.3
Mathematical Expectation,
B.4.4 Covariance and moments.

Chapter 5: Common discrete and continuous probability laws **(3 Weeks)**
Bernoulli, binomial, Poisson, ...; Uniform, normal, exponential, ...

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

Bibliographic references:

1. D. Dacunha-Castelle and M. Duflo. Probability and Statistics: Fixed-Time Problems. Masson, 1982.

2. J.-F. Delmas. Introduction to probability calculus and statistics. ENSTA handout, 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. Course in mathematical statistics. Economica, 1988.
7. A. Montfort. Introduction to Statistics. Ecole Polytechnique, 1991

Semester: 3

Teaching unit: UEM2.1.2 Subject 2:

Python Programming VHS: 45h00 (TD 1h30,

TP 1h30)

Credits: 2

Coefficient: 2

Subject objectives:

- Acquire the practical basics of programming with Python
- Develop algorithmic logic to solve simple problems
- Learn 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 (navigating files, text editor)

Content of the subject:

Chapter 1. Installing and Using Python Chapter

2. Basics *2-A. Interactive Mode and*

Script Mode , 2-A-1. Python Calculator , 2-

*A-2. Using Operators: +, -, *, /, //,*

*%, and ** , 2-A-3.c Precedence 2-B. Variable and Data Type : 2-B-1.*
Variable Initialization,

Variable Modification, Compound

Assignment 2-B-2. Data Type: (, Number, Character, String)

2-B-3. Conversion (str function)

2-C. Predefined 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 output (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 if Form, if-else Form, Full if-elif-else Form)

The limits of the simple if condition Comparison

operators Predicates and booleans The
keywords and, or and not

Chapter 4. Loops *The while loop*

The for loop

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic 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.. Learning to program with Python 3. Editions Eyrolles, 2012;

[6] .Le Goff, V.. Learn to program in Python. Editions Eyrolles, 2019;

[7] .Matthes, E. Python crash course: A hands-on, project-based introduction to programming. no starch press, 2019;

Practical work:

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

1. Install Python and a code editor (VS Code, PyCharm)
2. Getting Started with the Python Interpreter o
   Running Simple Commands in Interactive Mode
   o Using Python as a calculator
3. Creating and running a first Python script

TP 2: Variables, data types and operations **(1 Week)**

1. Manipulating fundamental data types
   o Integers, floats, strings, booleans
   o Conversion between data types
2. Arithmetic operations and priorities **TP 3:**

Conditional and repetitive structures 1. Conditional **(1 Week)**
instructions (if, elif, else)
2. Loops (for, while)

TP 4: Functions and modularity **(1 Week)**

1. Definition and calling of functions 2.
Parameters and return values

TP 5: Data structures 1. Manipulating **(1 Week)**
lists 2. Dictionaries and tuples

3. Browsing and manipulating data structures

TP 6: File manipulation and final project 1. Reading **(1 Week)**
and writing text files
2. Final project of your choice:
   ÿ Command line task manager
   ÿ Hangman game

ÿ Data analysis from a CSV file ÿ Interactive quiz with saving of scores

Assessment method:

Continuous assessment: 100%.

Bibliographic references: 1.

Cyrille, H. (2018). Learn to program with Python 3. Eyrolles, 6th edition. ISBN: 978-2212675214

2. Daniel, I. (2024). Learn to code in Python, I read **3.** Nicolas, B. (2024). Python, from the absolute beginner to object-oriented programming Course and corrected exercises, 3rd edition , Ellipses

4. Ludivine, C. (2024). Selenium Master your functional tests with Python, Eni **5.** Lutz, M. (2013). Learning Python, 5th edition OÿReilly. 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

Teaching unit: UEM 2.1 Subject 3:

Electronics and Electrical Engineering Practical Work VHS:

22h30 (Practical Work: 1h30)
Credits: 2

Coefficient: 1

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

Recommended prior knowledge: Basic electronics.
Basic electrical engineering.

Content of the subject:

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

Electronics 1 Practical
work 1: Fundamental theorems **Practical**
work 2: Characteristics of passive filters **Practical**
work 3: Characteristics of the diode / rectification **Practical work 4:**
Stabilized power supply with Zener diode **Practical work 5:**
Characteristics of a transistor and operating point **Practical work 6:** Operational amplifiers.

Electrical Engineering Practical
Work 1 Practical Work 1 : Measurement of single-phase voltages and currents **Practical Work 2 :** Measurement of three-phase voltages and currents Practical Work **3 :** Measurement of active and reactive power in three-phases Practical **Work 4 :** Magnetic circuits (hysteresis cycle)
TP 5 : Tests on transformers **TP 6 :** Electrical machines (demonstration).

Assessment method:
Continuous assessment: 100%

Bibliographic references:

Semester: 3

Teaching unit: UEM 2.1 Subject 4:
Practical work on Waves and vibrations

VHS: 3:00 p.m. (TP: 1:00 p.m.)
Credits: 1

Coefficient: 1

Teaching objectives The objectives assigned by this program focus on introducing students to putting into practice the knowledge received on the phenomena of mechanical vibrations restricted to low 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 subject:

TP1 : Mass – spring **TP2 :**

Simple pendulum **TP3 :**
Torsion pendulum **TP4 :**

Oscillating electric circuit in free and forced mode **TP5 :** Coupled pendulums

TP6 : Transverse oscillations
in vibrating strings **TP7 :** Grooved pulley according to Hoffmann **TP8 :**

Electromechanical systems (The electrodynamic loudspeaker)

TP9 : Pohl's pendulum **TP10 :**
Propagation of longitudinal waves in a fluid.

Note : It is recommended to choose at least 5 TPs from the 10 offered.

Assessment method:
Continuous assessment: 100%.

Bibliographic references:

Semester: 3

Teaching unit: UED 2.1

Subject 1: State of the art of electrical engineering

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 1

Coefficient: 1

Teaching objectives

To give the student a general overview of the different existing fields in Electrical Engineering while highlighting the impact of electricity in improving human daily life.

Recommended prior knowledge

None

Content of the subject:

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

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

Assessment method: Final exam: 100%.

Bibliographic references:

(Depending on the availability of documentation at the establishment level, websites, etc.)

Semester: 3

Teaching unit: UED 2.1 Subject 2:

Energy and environment VHS: 10:30 p.m.

(Course: 1:30 p.m.)

Credits: 1

Coefficient: 1

Teaching objectives: To introduce the student to 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 subject:

Chapter 1: Different Energy Resources

Chapter 2: Energy Storage

Chapter 3: Consumption, reserves and developments in energy resources

Chapter 4: The different types of pollution

Chapter 5: Detection and treatment of pollutants and waste

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

Assessment method:

Final exam: 100%.

Bibliographic references:

1- Jenkins et al., Electrotechnics of renewable energies and cogeneration, Dunod, 2008 2-Pinard, Renewable energies for electricity production, Dunod, 2009 3-Crastan, Power plants and alternative electricity production, Lavoisier, 2009 4-Labouret and Villoz, Photovoltaic solar energy, 4th ed., Dunod, 2009-10.

Semester: 4

Teaching unit: UEF 2.2.1

Subject 1: Linear and continuous servo systems

VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)

Credits: 6

Coefficient: 3

Teaching objectives:

This course will provide students with knowledge of the control theory of continuous linear systems as well as methods of representation and analysis. At 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, including the manipulation of values complexes, …)
- Fundamental notions of basic electronics (linear circuits) and physics.

Content of the subject:

Chapter 1: General information on servo systems Overview of the history of control systems, Terminology of servo systems (disturbance, setpoint, command, output, measurement noise, deviation, tracking, regulation), Automation functions (monitoring/safety, corrector, servo/regulation), Open loop/closed loop control, Structure and components of a control system. **(2 Weeks)**

Chapter 2: Laplace Transforms and Representation of Servo-Controlled Systems **(3 Weeks)**

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

Chapter 3: Time domain analysis 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 time response. **(2 Weeks)**

Chapter 4: Analysis of systems in the frequency domain **(4 Weeks)**

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

Chapter 5: Systems Synthesis **(4 Weeks)**

Introduction, Synthesis specifications (stability, speed, precision), Different structures

regulators (phase advance/lag, PID, RST), Choice of regulator according to the imposed specifications, Dimensioning of regulators: Synthesis by empirical methods (Ziegler-Nichols, Méplat, symmetrical, etc.), Synthesis by graphical methods (Evans, Bode, Black, Nyquist, etc.).

Assessment method:

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

Bibliographic references:

1- Y. Granjon, Automatic - linear and continuous systems, Dunod 2003.
2- S. Le Ballois and P. Cordon, Automatics - linear and continuous systems, 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

Teaching unit: UEF 2.2.1

Subject 2: Combinatorial and sequential logic

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

Understand common combinational circuits. Know how to design some applications of combinational circuits using standard tools such as truth tables and Karnaugh tables.
Introduce sequential circuits through flip-flop circuits, counters and registers.

Recommended prior knowledge None.

Content of the subject:

The number of weeks displayed is for informational purposes only. It is clear that the course leader is not required to strictly adhere to this dimension 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 Logical Functions. Representation of Logical Functions: Truth Tables, Karnaugh Tables. Simplification of Logical Functions: Algebraic Method, Karnaugh Method.

Chapter 2: Numbering Systems and Information Coding **2 weeks**

Representation of a number by codes (binary, hexadecimal, DCB, signed and unsigned binary, etc.), base change or conversion, unweighted codes (Gray code, error detection and correction codes, ASCII code, etc.), arithmetic operations in binary code.

Chapter 3: Combinational Transcoder Circuits **2 weeks**

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

Chapter 4: Combinational Switching Circuits **2 weeks**

Definitions, Multiplexers, Demultiplexers, Cascading, Applications, Analysis of the technical data sheet of a switching integrated circuit, List of integrated circuits.

Chapter 5: Combinational 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: Flip-Flops **2 weeks**

Introduction to sequential circuits. The RS flip-flop, the RST flip-flop, the D flip-flop, the master-slave flip-flop, the T flip-flop, the JK flip-flop. Examples of flip-flop applications: Frequency divider by n, Pulse train generator, etc.
It is advisable to present for each flip-flop the truth table, examples of timing diagrams as well as the limits and imperfections.

Chapter 7: Counters **2 weeks**

Definition, Classification of counters (synchronous, regular, irregular, asynchronous, complete and incomplete cycles). Construction of complete and incomplete synchronous binary counters, Excitation tables for JK, D and RS flip-flops, Construction of asynchronous binary counters modulo (n):

complete, incomplete, regular and irregular. Programmable counters (start from any state).

Chapter 8. Registers **1 Week**

Introduction, classic registers, shift registers, loading and retrieving data in a register (PIPO, PISO, SIPO, SISO), shifting data in a register, a general-purpose register, the 74LS194A, available integrated circuits, Applications: classic registers, special counters, queues.

Assessment method:

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

Bibliographic references:

1- J. Letocha, Introduction to Logic Circuits, McGraw Hill Edition.
2- JC Lafont, Course and problems in digital electronics, 124 exercises with solutions, Ellipses.
3- R. Delsol, Digital Electronics, Volumes 1 and 2, Edition Berti 4- P.
Cabanis, Digital Electronics, Edition Dunod.
5- M. Gindre, Combinatorial Logic, 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, Digital Electronics: Combinational Logic and Technology, McGraw Hill, 1987
9- C. Brie, Combinatorial and Sequential Logic, Ellipses, 2002.
10- JP. Ginisti, Combinatorial Logic, Paris, PUF (coll. “What do I know?” n°3205), 1997.
11- JL. Krivine, Lambda-calculus, types and models, Masson, 1990, chap. Combinatorial logic, English translation available on the author's website.

Semester: 4

Teaching unit: UEF 2.2.2

Subject 1: Architecture of Automated Systems

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 2

Coefficient: 1

Teaching objectives

To introduce students to Industrial Automated Systems (AS) and their Architecture.
Learn about the constituent bodies of SAs and their operating principles. This program is an introduction to various subjects from semesters five and six, where they will be detailed.

Recommended prior knowledge:

Content of the subject:

Chapter 1: Introduction Global approach to a production system, Objectives of production automation, Profitability of automation, Example of application. **(2 weeks)**

Chapter 2: Structure of a production system Decomposition of OPERATIVE PART and CONTROL PART (PO – PC), Elements of the PO and PC, Effector, Actuator (electric motor, pneumatic cylinder, etc.), Pre-Actuator (contactors, relays, pneumatic distributors), Sensor (TOR sensors, analog sensors, transmitters), Processing (API, industrial PC, etc.), Dialogue (HMI, SCADA, etc.). **(3 weeks)**

Chapter 3: Order Part (2 weeks)
PC Type, Architecture, Programming

Chapter 4: Architecture of production systems Autonomous machines, Associated machines in line, Production cell with centralized control, Cell with decentralized and coordinated control, Flexible cell with distributed and hierarchical control. **(3 weeks)**

Chapter 5: Network concepts Industrial local networks, Computer networks. **(2 weeks)**

Chapter 6: Presentation and case study (3 weeks)
Electrical distribution, petrochemical process regulation, thermal, furnaces, etc.

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%.

Bibliographic references:

1- Industrial process control architectures Engineering technique AG3510
2- Automation and industrial processes in the food industry Engineering technique F1290
3- Industrial programmable controllers S8015 engineering technique
4- Jean-Pierre THOMESSE, Industrial local networks - Concepts, typology, characteristics Technical engineer Ref.S7574v1

Semester: 4

Teaching unit: UEF 2.2.2

Subject 2: Signal Theory

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives :

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

Recommended prior knowledge:

Basic math course.

Content of the subject:

Chapter 1. General information on signals (3 Weeks)

Objectives of signal processing. Areas of use. Classification of signals (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.). Examples of basic signals (rectangular pulse, triangular pulse, ramp, step, sign, Dirac, etc.)

Chapter 2. Fourier Analysis (4 Weeks)

Introduction, Mathematical reminders (scalar product, Euclidean distance, linear combination, orthogonal basis, 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 translation-invariant systems or SLIT (Time and Frequency Analysis).

Chapter 4. Convolution Product (2 Weeks)

Formulation of the convolution product, Properties of the convolution product, Convolution product and Dirac momentum.

Chapter 5. Signal Correlation Signals (3 weeks)

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

Assessment method:

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

Bibliographic references:

1. S. Haykin, “Signals and systems”, John Wiley & Sons, 2nd ed., 2003.
2. AV Oppenheim, “Signals and systems”, Prentice-Hall, 2004.
3. F. de Coulon, “Theory and processing of signals”, Edition PPUR.
4. F. Cottet, “Signal processing and data acquisition, Course and solved exercises”, Dunod.
5. B. Picinbono, “Signal and Systems Theory with Solved Problems”, Bordas Edition.
6. M. Benidir, “Signal Theory and Processing, Volume 1: Representation of Signals and Systems - Courses and corrected exercises", Dunod, 2004.
7. M. Benidir, “Signal Theory and Processing, Volume 2: Basic Methods for Signal Analysis and Processing - Course and Corrected Exercises”, Dunod, 2004.
8. J. Max, Signal Processing

Semester: 4

Teaching unit: UEM 2.2.2

Subject 1: Numerical Methods

VHS: 67h30 (Lecture: 1h30, Tutorial: 1h30, Practical: 1h30)

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 Science 1 and Computer Science 2.

Content of the subject:

Chapter 1. Solving nonlinear equations f(x)=0 (3 Weeks)

1. Introduction to calculation errors and approximations, 2. Introduction to methods for solving nonlinear equations, 3. Bisection method, 4. Method of successive approximations (fixed point), 5. Newton-Raphson method.

Chapter 2. Polynomial Interpolation 1. General **(2 Weeks)**
Introduction, 2. Lagrange Polynomial, 3. Newton Polynomials.

Chapter 3. Function Approximation: (2 Weeks)

1. Approximation method and quadratic mean. 2. Orthogonal or pseudo-Orthogonal systems. Approximation by orthogonal polynomials, 3. Trigonometric approximation.

Chapter 4. Digital Integration (2 Weeks)

1. General introduction, 2. Trapezoid method, 3. Simpson's method, 4. Quadrature formulas.

Chapter 5. Solving Ordinary Differential Equations
(Initial condition or Cauchy problem) **(2 Weeks)**

1. General Introduction, 2. Euler's Method, 3. Improved Euler's Method, 4. Runge's Method-Kutta.

Chapter 6. Direct method of solving systems of linear equations (2 weeks)

1. Introduction and definitions, 2. Gaussian method and pivoting, 3. LU factorization method, 4. Choeleski factorization methodMMt , 5. Thomas algorithm (TDMA) for diagonal sorting systems.

Chapter 7. Method for Approximate Resolution of Systems of Linear Equations
(2 Weeks)

1. Introduction and definitions, 2. Jacobi method, 3. Gauss-Seidel method, 4. Use of relaxation.

Assessment method:

Continuous assessment: 40% (20% TD + 20% TP); Final exam: 60%.

Numerical Methods Practical Work

Teaching objectives:

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

Recommended prior knowledge: Numerical Method, Computer Science 2 and Computer Science 3.

Content of the subject:

Chapter 1: Solving Nonlinear Equations 1. Bisection Method. 2. Fixed Point Method, 3. Newton-Raphson Method — **3 weeks**

Chapter 2: Interpolation and Approximation 1. Newton's Interpolation, 2. Chebyshev's Approximation — **3 weeks**

Chapter 3: Numerical Integrations 1. Rectangle Method, 2. Trapezoid Method, 3. Simpson Method — **3 weeks**

Chapter 4: Differential Equations 1. Euler's Method, 2. Runge-Kutta Methods — **2 weeks**

Chapter 5: Systems of Linear Equations 1. Gauss-Jordon Method, 2. Crout Decomposition and LU Factorization, 3. Jacobi Method, 4. Gauss-Seidel method — **4 weeks**

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1. José Ouin, Algorithmics and numerical calculation: Solved practical work and programming with Scilab and Python software, Ellipses, 2013.
2. Bouchaib Radi, Abdelkhalak El Hami, Mathematics with Scilab: guide to calculation, programming, graphic representations; conforms to the new MPSI program, Ellipses, 2015.
3. Jean-Philippe Grivet, Applied Numerical Methods: for Scientists and Engineers, EDP sciences, 2009.
4. C. Brezinski, Introduction to the practice of numerical calculation, Dunod, Paris 1988.
5. G. Allaire and SM Kaber, Numerical Linear Algebra, Ellipses, 2002.
6. G. Allaire and SM Kaber, Introduction to Scilab. Corrected practical exercises in linear algebra, Ellipses, 2002.
7. G. Christol, A. Cot and C.-M. Marle, Differential Calculus, Ellipses, 1996.
8. M. Crouzeix and A.-L. Mignot, Numerical Analysis of Differential Equations, Masson, 1983.
9. S. Delabrière and M. Postel, Approximation Methods. Differential Equations. Scilab Applications, Ellipses, 2004.
10. J.-P. Demailly, Numerical Analysis and Differential Equations. Grenoble University Press, 1996.
11. E. Hairer, SP Norsett and G. Wanner, Solving Ordinary Differential Equations, Springer, 1993.
12. PG Ciarlet, Introduction to matrix numerical analysis and optimization, Masson, Paris, 1982.

Semester: 4

Teaching unit: UEM 2.2

Subject 1: Electrical and electronic measurements

VHS: 45h00 (Lecture: 1h30, Practical work: 1h30)

Credits: 3

Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge: General Electricity, Fundamental Laws of Physics.

Content of the subject:

The number of weeks displayed is for informational purposes only. It is clear that the course leader is not required to strictly adhere to this dimension or the arrangement of the chapters.

Chapter 1. Measurements, quantities and uncertainties **5 weeks**

Introduction, Quantity, Standard, Unit systems, Table of multiples and submultiples, Dimensional equations, Useful formulas, Measurement precision, Measurement error, Classification of errors, Uncertainties in indirect measurements, Qualities of measuring devices, Calibration of measuring devices, Graphic symbols of measuring devices, General measurement methods (Deviation, zero, resonance methods), Application exercises.

Chapter 2. Measurement Methods 1. **6 weeks**

Voltage Measurements: Direct Voltage Measurement Methods, Alternating Voltage Measurements, Indirect Voltage Measurement Method by the Opposition Method.

2. Current measurement: Direct method of current measurement, Use of simple Shunt.

3. Resistance measurements: Classification of resistances, Voltammetric method, Zero method: The Wheatstone Bridge, Measurement of very large resistances by the charge loss method.

4. Impedance measurements: Capacitance measurements, Inductance measurements, AC bridges.

5. Continuous Power Measurements: Fundamental Relationship, Ammeter and Voltmeter Method, Continuous Electrodynamic Wattmeter.

6. AC Power Measurements: Instantaneous and average power, Complex power, apparent power, active power and reactive power, Electrodynamic AC Wattmeter, 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 using an oscilloscope, Measurement of phase shifts using Lissajous figures.

8. Frequency and period measurements: Direct frequency measurement with an oscilloscope, Frequency measurement with Lissajous figures, Frequency measurement using the frequency meter method, Frequency measurement using the period meter method, Application exercises.

Chapter 3. Measuring Devices Introduction **4 weeks**

Analog measuring devices : Classification of deflection devices, The moving coil galvanometer, Structure of the magnetoelectric ammeter, Structure of the magnetoelectric voltmeter, Operation of the electrodynamic wattmeter in alternating current

Digital measuring devices: Analog-to-digital converters (ADCs), Operating principle of a digital measuring device, Examples of digital measuring devices (Multimeter, Oscilloscope, etc.).

Electrical and electronic measurements:

TP No. 1: Resistance measurement:

Measure resistance using the following 5 methods: voltammetric, ohmmeter, Wheatstone bridge, comparison and substitution.
Compare these methods with each other and establish an error calculation.

TP No. 2: Inductance measurement:

Carry out the measurement of inductances using the following 3 methods: voltammetric, Maxwell bridge, resonance.
Compare these methods with each other and establish an error calculation.

TP No. 3: Capacity measurement:

Carry out capacity measurements using the following 3 methods: voltammetric, Sauty bridge, resonance.

Compare these methods with each other and establish an error calculation.

TP No. 4: Phase shift

measurement: Measure the resistances using the following 2 methods: Phase meter and oscilloscope.

TP No. 5: Single-phase power measurement:

Measure the resistance using the following 5 methods: wattmeter, Cosÿmeter, three voltmeters, three ammeters, power sensor.
Compare these methods with each other and establish an error calculation.

TP No. 6: Three-phase power measurement:

Carry out resistance measurements using the following methods: Star system and delta system, balanced and unbalanced.

Assessment method:

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

Bibliographic references:

1- M. Cerr, Industrial Instrumentation: T.1, Tec and Doc Edition.
2- M. Cerr, Industrial Instrumentation: T.2, Tec and Doc Edition.
3- P. Oguic, Measurements and PC, ETSF Edition.
4- D. Hong, Electrical Circuits and Measurements, Dunod, 2009.
5- W. Bolton, Electrical and Electronic Measurement and Testing, 1992.
6- A. Fabre, Electrical and electronic measurements, OPU, 1996.
7- G. Asch, Sensors in industrial instrumentation, Dunod edition, 2010.
8- L. Thompson, Electrical Measurements and Calibration: Fundamentals and Applications, Instrument Society of America, 1994.
9- JP Bentley, Principles of Measurement Systems, Pearson Education, 2005.
10- J. Niard, Electrical measurements, Nathan, 1981.
11- P. Beauvilain, Electrical and Electronic Measurements.
12- M. Abati, Applied electronic measurements, Delagrave Techniques and Standardization Collection.
13- P. Jacobs, Electrical Measurements, Dunod Edition.
14- A. Leconte, Measurements in electrotechnics (Document D 1 501), The engineering techniques.

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

Teaching unit: UEM 2.2

Subject 2: Practical work on linear and continuous servo systems

VHS: 10:30 p.m. (TP: 1:30 p.m.)
Credits: 1

Coefficient: 1

Teaching objectives

To introduce students to the practical application of their knowledge of control systems theory. To teach students how to use tools to model, analyze, and design simple controllers for automated systems.

Recommended prior knowledge: Linear and continuous servo systems. Fundamentals of electronics and physics

Content of the subject:

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

Part 01: PC simulation practical work (theoretical part)

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

Using Matlab software commands such as: *ode45, ode123, Rank-Kutta* of order 4, …
etc.

TP N°2: Determination of the transfer function of a system and plotting of the time and frequency responses

Using commands : *Ident, Step, Impulse, Lsim, Ltiview, Bode, Nyquist, etc.*

TP N°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, disturbance,* measurement *noise* , etc.
Use the *RLTOOL* command to synthesize the controller that stabilizes the transfer function.

Improve the performance of the loop system by adding poles and zeros in the corrector provided by the RLTOOL command.

Part 02: Practical validation

TP N°1: Modeling and identification of an RLC electrical circuit by a first/second order model (random excitation by a voltage generator and measurement of the output voltage by a voltmeter). Same thing for the two temperature sensors NTC and PT100.

TP N°2: Study of a PID corrector produced using operational amplifiers.

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

TP No. 4: Adjustment of a first-order system by a P and PI regulator.

TP No. 5: Adjustment of a second-order system by a P, PI and PID regulator.

TP No. 6: Adjusting the speed of a direct current motor.

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1-S. Le Ballois, P. Codron, Automatics: Linear and continuous systems, Dunod 2006.

2- P. Prouvost, Automatic - Control and regulation Course, exercises and corrected problems, Dunod 2010.

3- E. Godoy, Industrial Regulation Modeling tools, methods and control architectures, Dunod.

Semester: 4

Teaching unit: UEM 2.2

Subject 3: Practical work on combinatorial and sequential logic

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives:

Consolidate the knowledge acquired during the course of the subject "Combinatory 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 subject:

The teacher chooses from this list of practical work between 4 and 6 practical work to carry out and covering the two types of logic circuits (combinatory and sequential).

TP1: TTL and CMOS integrated circuit technology.
Understand and test the different logic gates

TP2: Simplification of logical equations through practice
Discover the rules for simplifying equations in Boolean algebra through practice

TP3: Study and implementation of common combinatorial logic functions
Example: switching circuits (MUX, DMUX), coding and decoding circuits, etc.

TP4: Study and creation of an arithmetic combinational circuit
Creation of an adder and/or subtractor circuit for 2 4-bit binary numbers.

TP5: Study and creation of a combinational logic circuit
Implementing a logic function using logic gates. For example, a 7-segment display and/or a 2's complement generator for a 4-bit number and/or a 4-bit Gray code generator, etc.

TP6: Study and creation of a combinational logic circuit
Complete study (Truth table, Simplification, Logic diagram, Practical assembly and Tests) of a combinational circuit based on specifications.

TP7: Study and creation of meter circuits
Incomplete asynchronous counter circuits using flip-flops, Irregular cycle synchronous counter circuits using flip-flops

TP8: Study and creation of registers

Assessment method:

Continuous assessment: 100%

Bibliographic references:

1. J. Letocha, Introduction to Logic Circuits, Mc-Graw Hill Edition.
2. JC Lafont, Course and problems in digital electronics, 124 exercises with solutions, Edition Ellipses.

Semester: 4

Teaching 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: This course aims 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 framework), 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 communication (avoiding plagiarism, correctly citing sources, etc.).

Prerequisites:

Students must have a scientific baccalaureate or equivalent level, with a good command of written and spoken French. Basic computer skills are recommended (word processing, internet browsing, email).

Content of the material:

Chapter 1: Introduction to scientific communication 1 week

Course presentation, issues of scientific communication (written and oral), examples of materials (articles, reports, presentations). Awareness of the importance of integrity and ethics in academic work.

Chapter 2: Documentary research and ICT **1 week**

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

Chapter 3: Referencing and Bibliography **1 week**

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

Chapter 4: Structure of a Scientific Document **1 week**

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

Chapter 5: Writing the scientific document Writing the introduction and the abstract: **3 weeks**

How to write an effective introduction: presenting the background, formulating the research question and objectives. Writing an informative abstract: structure (background, 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 section (clear presentation of data, use of tables/figures). Distinction between facts (results) and interpretation (discussion). Clarity rules: simple sentences, active voice/precision of verbs.

Discussion, conclusion and style:

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

Chapter 6: Introduction to Oral Presentation and Public Speaking Techniques **2**

Oral presentation methodology: prepare a plan (introduction, body, conclusion), define your objective, and understand your audience. The importance of an engaging introduction (hook) and a summary conclusion.

Public speaking techniques:

Body and vocal techniques to capture attention: posture, gestures, gaze, variations in tone and rhythm. Stress and stage fright management. Best practices: do not read your notes word for word, only bring keywords to avoid putting the audience to sleep. Use of supports (paper, slides).

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

Use of computer tools (PowerPoint, Beamer, etc.) to create slides. Basic principles: clear and legible slides (KISS), use of relevant diagrams/images, appropriate fonts and colors. Do not overload the slides. Demonstration of screen capture or editing software for researching scientific content (Zotero, databases, Google Drive).

Chapter 8: Professional Written Expression Written **1 week**

communication techniques outside of articles: writing academic emails (clear subject lines, polite phrases), meeting reports, project summaries. Notions of formal style (objectivity, impersonality). Spelling and grammar – review of common errors (agreement, conjugation, word confusion).

Chapter 9: Interpersonal Communication and Listening Weeks **1**

Group communication dynamics: active listening, argumentation, and reformulation. The role of speaking 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 individuals.
Examples of violations (plagiarism, data fabrication, authorship fraud).
Presentation of national university charters and regulations (obligations and sanctions).
Emphasize the importance of “intellectual integrity” in research.

Chapter 11: Scientific Standards and Practices weeks **1**

Summary of international publication standards (peer-reviewed journals, impact factors, peer reviews). Standard formats (APA, etc.) discussed earlier. Rules for presenting exams and reports (margins, font, pagination). Introduction to writing a mini-project or internship report.

Workshops:

Workshop: Note-taking exercise during a short video or scientific text; sharing 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 the summaries; critical evaluation of the reliability of the sources (evaluator, date, content).

ATL 3: Citation Exercise: Identify and format references in a given text. Create a bibliography using 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 in each section.
ATL 5:

- Writing a 150-200 word summary from a scientific article or short presentation provided. Exercises in reformulating arguments for the introduction.
- Writing exercise: briefly describe a simple method or experiment based on a given protocol. Create tables or graphs from simulated data.
- Revision workshop: starting from 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 the argumentation and the structure.
- Short individual oral presentations on a familiar topic, with video recording Optional. Self-assessment and group feedback on voice and gestures.

ATL 7: Creation of a short slideshow (3–5 slides) on a simple scientific topic. Discussion on visual effectiveness.
ATL 8 : Writing a professional email to a teacher or supervisor (request for information, project submission). Collaborative correction of a text to eliminate errors.
common.
ATL 9 : Role play: structured debate on a scientific topic (with speaking turns), or peer-to-peer feedback on a mini-presentation.

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

Assessment method:

Review: 100%.

Bibliographic references:

1. D. Lindsay & P. Poindron (2011), Scientific Writing Guide: The Hypothesis, Keystone of the Scientific Article, Éditions Quae, Versailles.
2. JE Harmon & AG Gross (2010), The Craft of Scientific Communication, University of Chicago Press.
3. Ministry of Higher Education and Scientific Research (Algeria), Charter of University Ethics and Professional Conduct, 2010 (see in particular the emphasis on academic integrity), https://www.mesrs.dz/index.php/fr/ethique-et-deontologie/charte-ethique-et-deontologie/.
4. Baril. D (2008), Techniques of written and oral expression, Sirey .
5. Jean-Denis Commeignes (2013), 12 methods of written and oral communication – 4th edition, Michelle Fayet and Dunod.
6. Cardon, D. (2019). *Digital Culture,* Paris, Presses de Sciences Po
7. Frédéric Wauters (2023). Writing Effectively in the Digital Age: Written Communication Techniques, 2nd Edition - ISBN 978-2-8073-3772-5.
8. Chartier, M. (2013). The web referencing guide. First.
9. Duarte, N. (2019). *DataStory: Explain Data and Inspire Action Through Story* Story Paperback. IdeapressPublishing.ISBN-10 : 1940858984
10. Levan, SK (2000). *The Workflow Project:* Concepts and tools for organizations. Eyrolles.
11. Anderson, C. (2016). *TED Talks: The Official TED Guide to Public Speaking* (1st edition). Houghton Mifflin Harcourt.
12. Reynolds, G. (2009). *Presentation Zen: For simpler, clearer, and more impactful presentations* . Pearson.
13. Thierry, L. (2014). Introduction to communication - 2nd. Dunod.
14. Serres, A. (2021). *In the labyrinth: Evaluating information on the internet.* C&F Éditions.

Semester: 5

Teaching unit: UEF 3.1.1

Subject 1: Control of linear systems

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4

Coefficient: 2

Teaching objectives:

This module is a consolidation of the knowledge acquired in the second year and allows mastery of the representation of dynamic 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.

Content of the material:

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, Settings using the Black-Nichols chart.

Chapter 2. State Representation of Systems (2 Weeks)

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

Chapter 3. State Space Systems Analysis (3 Weeks)

Resolution of state equations and transition matrix, Methods for calculating the transition matrix, Modal analysis (diagonalization), Stability, Notions of controllability and observability (definitions and test methods).

Chapter 4. Command by return of status (3 Weeks)

Formulation of the pole placement problem by state feedback, Calculation methods for monovariable systems, Case of multivariable systems, Implementation.

Chapter 5. State Observer Synthesis (3 Weeks)

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

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. Philippe de Larminat, “Automation: Control of linear systems”, Hermès Lavoisier, 1996.
2. Hubert Egon, “Sampled linear servoing and state representation”, Methods, 2001.
3. Luc Jaulin, “State representation for modeling and controlling systems”, Lavoisier, 2005.
4. Robert L. Williams, Douglas A, “Lawrence, Linear State-Space Control Systems”, Edition John Wiley & Sounds, 2007.
5. R. Longchamp, “Digital control of dynamic systems”, Presses Polytechniques et Universitaires Romandes, 1995.
6. GF Franklin, JD Powell, LM Workman, “Digital control of dynamic systems”, Addison-Wesley Series in Electrical and Computer Engineering: Control Engineering, 1990.
7. KJ Aström, B. Wittenmark, “Computer controlled systems: theory and design”, Prentice-Hall, 1984.
8. RH Middleton, GC Goodwin, “Digital control and estimation: a unified approach”, Prentice Hall, 1990.

Semester: 5

Teaching unit: UEF 3.1.1

Subject 2: Power electronics

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

Know the basic principles of power electronics, Know the operating principle and use of power components, Master the operation of the main static converters, Acquire the basic knowledge for a technical choice according to the field of application of a power converter.

Recommended prior knowledge

Fundamental electronics 1, Fundamental electrical engineering 1.

Content of the subject:

The number of weeks displayed is for informational purposes only. It is clear that the course leader is not required to strictly adhere to this dimension 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 (effective values, average values, form factor, ripple rate).

Chapter 2. AC - DC Converters 3 weeks

Power elements (diodes and thyristors), Single-phase rectification, load type R, RL, RLE., Three-phase rectifiers, load types R, RL, RLE. Analysis of the commutation phenomenon (encroachment) in uncontrolled and controlled static rectification converters.

Chapter 3. AC-AC Converters 3 weeks

Power elements (triacs with a fast return on diodes and thyristors), Single-phase dimmer, with load R, RL. Principle of the single-phase Cycloconverter

Chapter 4. Direct Current - Direct Current Converters 3 weeks

Power elements (GTO thyristor, bipolar transistor, MOSFET transistor, IGBT transistor), Buck and boost chopper, with load R, RL and RLE.,

Chapter 5. Direct current - alternating current converters Single-phase inverter, half-bridge and bridge circuit with R and RL load. **3 weeks**

Assessment method:

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

Bibliographic references:

1. L. Lasne, “Power Electronics: Course, Case Studies and Corrected Exercises”, Dunod, 2011.

2. P. Agati et al. “Aide-mémoire: Electricity-Control and power electronics–Electro-technology”, Dunod, 2006.

3. J. Laroche, “Power Electronics – Converters: Course and Corrected Exercises”, Dunod, 2005.

4. G. Séguier et al. “Power Electronics: Course and Corrected Exercises”, 8th edition; Dunod, 2004.

5. D. Jacob, “Power electronics - Operating principle, dimensioning”, Ellipses Marketing, 2008.

6. G. Séguier, “Power electronics, basic functions and their main applications”, Tech et Doc.

7. H. Buhler, “Power Electronics”, Dunod
8. CW Lander, “Power Electronics,” McGraw-Hill, 1981
9. H. Buhler, “Regulation and Control Electronics; Treatise on Electricity”.
10. F. Mazda, “Power Electronics Handbook: Components, Circuits and Application”, 3rd Edition, Newness, 1997.
11. R. Chauprade, “Controls of alternating current motors (Power electronics)”, 1987.
12. R. Chauprade, “Direct current motor controls (Power electronics)”, 1984.

Semester: 5

Teaching unit: UEF 3.1.1

Subject 3: Modeling and identification of systems

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 2

Coefficient: 1

Teaching objectives:

The objective of this course is to present fundamental concepts and basic methods that enable an automation engineer to develop representation models describing the input-output behavior of a process to be controlled with the aim of developing a high-performance regulator.

Recommended prior knowledge: Basic notions in mathematics and servo systems.

Content of the material:

Chapter 1. Modeling (3 Weeks)

Representation model, Knowledge model (modeling of mechanical, electrical, fluidic, thermal systems, etc.).

Chapter 2. Reminder of basic methods in Automatics Time response of a system, Direct identification from the time response, Frequency approach. **(4 Weeks)**

Chapter 3. Model Adjustment Principle (4 Weeks)

Linear model with respect to the parameters, Minimization of the adjustment criterion and calculation of the optimal solution, Matrix writing of the least-squares method.

Chapter 4. Analysis of the Least Squares Method Estimation Bias, Estimation Variance, Maximum Likelihood Estimator, Rejection of Outlier Measurements. **(3 Weeks)**

Chapter 5. Recursive Least Squares Principle of recursive calculus, Implementation of the recursive method, Weighting factor, forgetting factor. **(1 Week)**

Assessment method:

Review: 100%.

Bibliographic references:

1. Jean-François Massieu, Philippe Dorléans, “Modeling and analysis of linear systems”, Ellipses, 1998.
2. Pierre Borne, Geneviève Dauphin-Tanguy, Jean-Pierre Richard, “Modeling and identification of processes”, Technip, 1992.
3. Ioan D. Landau, “Identification of Systems”, Hermès, 1998.
4. E. Duflos, Ph. Vanheeghe, “Estimation Prediction”, Technip, 2000.
5. R. Ben Abdenour, P. Borne, M. Ksouri, M. Sahli, “Identification and digital control of industrial processes”, Technip, 2001.

Semester: 5

Teaching unit: UEF 3.1.2

Subject 1: Microprocessors and Microcontrollers

VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6

Coefficient: 3

Teaching objectives:

This course allows students to understand the operation of microprocessors, their peripherals and their interfacing. It also allows them to become familiar with the different types of computers used in industrial installations.

Recommended prior knowledge: Combinatorial and sequential logic, Programming concepts.

Content of the material:

Chapter 1. Microprocessor Architecture Introduction to microprocessor-based systems, External architecture of a microprocessor, Internal architecture of a microprocessor. **(2 Weeks)**

Chapter 2. Introduction to the Instruction Set and Interrupts (4 Weeks)
The instruction set, The mnemonic code, Addressing modes, Interrupts.

Chapter 3. Memories Introduction, Memory Technology: ROM, RAM, Refresh Techniques, Memory Characteristics, Addressing Modes. **(2 Weeks)**

Chapter 4. Interfaces Serial interface, Parallel interface. **(2 Weeks)**

Chapter 5. The microcontroller General information on the microcontroller, Microcontroller architecture, Peripherals, Interrupts, Programming microcontrollers, Practical application. **(5 Weeks)**

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. A. Farouki, T. Laroussi, T. Benhabiles, “8086 Microprocessors”, Univ. Constantine.
2. JY Haggège, “Microprocessor: Course support”, INSET, 2003.
3. Lilen, “Fundamental course on microprocessors”, Dunod, 1993.
4. Alain-Bernard Fontaine, “The 16-bit Microprocessor-8086-8088”, 2nd edition, Computer Manuals”, Masson, 1997.
5. Michel Aumiaux, “16-bit Microprocessors”, 1997.
6. J. Crisp, “Introduction to microprocessors and microcontrollers”, Elsevier, 2nd edit 2004.
7. Christian Tavernier, “PIC 10, 12, 16 Microcontrollers, Description and Implementation”, Dunod, 2007.
8. Pascal Mayeux, “Learning Mid-Range PIC Programming Through Experimentation and simulation”, Dunod, 2010.

Semester: 5

Teaching unit: UEF 3.1.2

Subject 2: Programming in C++

VHS: 10:30 p.m. (Class: 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 of mathematics, Notions of algorithms, Numerical methods, Binary logic.

Content of the material:

Chapter 1. Presentation of the C++ language (1 Week)

History, C++ development environment (object creation, compilation, debugging, execution, etc.).

Chapter 2. Basic syntax in C++ language **(1 Week)**

Instructions Comments, Keywords and reserved words – Constants and variables, Fundamental types Operators (unitary, binary, priority, etc.).

Chapter 3. Conditional Structures and If/else Loops, **(2 Weeks)**

Switch/case, For Loop, While Loop, Do/while Loop.

Chapter 4. Inputs/Outputs (2 Weeks)

Output stream for display, Keyboard input stream, Case of character strings, files.

Chapter 5. Pointers and Arrays (2 Weeks)

Pointers, References, Static Arrays, Arrays and Pointers, Dynamic Arrays, Multidimensional Arrays.

Chapter 6. Functions **(2 Weeks)**

Prototype of a function, Definition of a function, Calling a function, Passing arguments to a function, Overloading a function, Files.

Chapter 7. Object-oriented programming in C++ **(5 Weeks)**

Introduction, Concept of classes and objects, Inheritance, Special methods (constructors, destructors, etc.), Procedural or structured programming, Object-oriented programming.

Assessment method:

Review: 100%.

Bibliographic references:

1. Bjarne Stroustrup, Marie-Cécile Baland, Emmanuelle Burr, Christine Eberhardt, “Programming: Principles and Practice with C++”, Pearson Edition, 2012.
2. Jean-Cédric Chappelier, Florian Seydoux, “C++ through practice. Collection of corrected exercises and help-memory”, PPUR Edition: 3rd edition, 2012.
3. Jean-Michel Léry, Frédéric Jacquenot, "Algorithmics, applications to C, C++ languages in Java", Edition Pearson, 2013.
4. Frédéric DROUILLON, “From C to C++ - From procedural programming to the object”, Eni; Edition: 2nd edition, 2014.
5. Claude Delannoy, “Programming in C++ language”, Edition Eyrolles, 2000.
6. Kris Jamsa, Lars Klander, “C++ The Programmer’s Bible”, Edition Eyrolles, 2000.
7. Bjarne Stroustrup, “The C++ Language,” Addison-Wesley Publishing, 2000.

Semester: 5

Teaching unit: UEM 3.1.1 Subject 1:

Practical work on linear systems control VHS:

22:30 (practical work: 1:30)

Credits: 2

Coefficient: 1

Teaching objectives: To 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.

Content of the material:

TP1: Introduction to MATLAB/Simulink

TP2: Study and synthesis of regulators in the frequency domain

TP3: State representation in canonical forms

TP4: Study and analysis of systems in state space

TP5: Study and synthesis of regulators by pole placement

TP6: Study and synthesis of state observers

Assessment method:

Continuous assessment: 100%.

Semester: 5

Teaching unit: UEM 3.1.1

Subject 2: Power Electronics Practical Work

VHS: 10:30 p.m. (TP: 1:30)

Credits: 2

Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge: Power electronics course content.

Content of the material:

TP No. 1. Uncontrolled rectifiers: single-phase and three-phase

Analyze the evolution of the voltage and current at the converter output with resistive and inductive loads, Analyze the evolution of the currents and voltages of the semiconductors in the two cases of resistive and inductive loads, Determine the form factor and the ripple rate.

TP No. 2. Controlled rectifiers, single-phase and three-phase

Analyze the evolution of the voltage and current at the converter output with resistive and inductive loads, Analyze the evolution of the currents and voltages of the semiconductors in the two cases of resistive and inductive loads, Determine the form factor and the ripple rate.

TP No. 3. Choppers, series chopper, parallel chopper

Study the behavior of a series chopper on the inductive load and in particular determine the shape of the current absorbed by the load during operation in transient then permanent mode, Understand the operation by observing the characteristic signals of the assembly and comparing them to the results of the TD on the parallel chopper.

TP No. 4. Single-phase inverters

To study the operation of single-phase voltage inverters and, on the other hand, the filtering of the resulting waveforms. "Active" and "passive" filtering solutions will be discussed.

TP No. 5. Single-phase and three-phase dimmers

Study the operation of a dimmer supplying different types of loads (R and RL) and compare the different results obtained theoretically in class with the practical results (formulas and timing diagrams).

Assessment method:

Continuous assessment: 100%.

Semester: 5

Teaching unit: UEM 3.1.1

Subject 3: Practical work Modeling and identification of systems

VHS: 10:30 p.m. (TP: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives:

The aim of these practical exercises is to put into practice the modeling and identification methods presented during.

Recommended prior knowledge: The student must be proficient in computer tools, in particular simulation using the MATLAB Simulink toolbox, Course in modeling and identification of systems.

Content of the material:

TP1: Introduction to MATLAB/Simulink

TP2: Simulation of a system described by the state equation and transfer function (Simulink)

TP3: Non-parametric identification using the deconvolution method

TP4: Non-parametric identification by the correlation method

TP5: Parametric identification using the Broïda method

TP6: Least squares method

Assessment method:

Continuous assessment: 100%.

Semester: 5

Teaching unit: UEM 3.1.2 Subject 1:

Practical work on Microprocessors and Microcontrollers

VHS: 22h30 (practical work: 1h30)

Credits: 2

Coefficient: 1

Teaching objectives: Acquire the ability to implement a small system based on microcontrollers and microprocessors through 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, flip-flops, counters, registers), Computer architecture, Knowledge of an assembler language.

Content of the material:

TP1: Getting started with the 6809/8086 emulator

TP2: Arithmetic and logical operations on the microprocessor

TP3: Application of different addressing modes

TP4: Interruptions

TP5: Learn to program with a PIC 16F84

TP6: Control of a display (7 segments, LCD)

Assessment method:

Continuous assessment: 100%.

Semester: 5

Teaching unit: UEM 3.1 Subject 2:

Practical work Programming in C++

VHS: 22h30 (practical work: 1h30)
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

Content of the material:

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

TP 2: Elementary syntax, declaration of variables and operators

TP 3: Conditional structures and loops

TP 4: Arrays and pointers

TP 5: Functions

TP 6: Files

TP 7: Object-oriented programming in C++
Classes, Special methods (constructors, destructors, etc.), Inheritance

Assessment method:
Continuous assessment: 100%.

Semester: 5

Teaching unit: UED 3.1
Subject 1: Standards and Certification

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 1

Coefficient: 1

Teaching objectives:

The objective of this course is to provide the student with 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 this type of certificate.

Recommended prior knowledge: None.

Content of the material:

Chapter 1. Introduction (1 Week)

- Definitions (ISO/IEC Guide 2 2004) Standardization, norm, standard, consensus. Comments

Chapter 2. Objectives of standardization and benefits of standardization - Reminder of the history of quality: from crafts to digital industry **(1 week)**

-Quality and quality assurance
-Roles of standardization

-Advantages of a quality system (ISO 9000 for example)

Chapter 3. Commercial legislation - Law, decree, circular etc. regulatory text and standard **(1 Week)**

-Standardization and economic actors

Examples: the PC computer versus Apple, IBM PC versus 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 - Concept of voluntary standard **(2 Weeks)**

-Internal or local organizations: European and American organizations, Algerian organizations

- International organizations: the CGPM and the SI system, ISO, EN standards, specific standards in electricity and telecommunications

Chapter 5. Standards Development, Standardization and Safety (3 Weeks)

-Standards production: case of Afnor and Ianor, organization and operation of the Algerian standardization, process of developing Algerian standards

- Main legal texts relating to standardization in Algeria
-Standardization and security

-Applications to domestic electrical safety:

- Creation of a compliant domestic electrical installation (example of the standard nfc18510): distribution of circuits (depending on their use), choice of wire sections and line circuit breakers.

- Carrying out the grounding according to standards

Chapter 6. Certification - Accreditation **(4 Weeks)**

-Certification

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

Chapter 7. ISO 9000 Standards - Description **(2 Weeks)**

- The ISO 9000
family - Scope of the

different ISO 9000 standards - Important notes on ISO 9001:2015 and

ISO 9004:2015

Assessment method:

Exam: 100%.

Bibliographic reference:

1. Robert Obert, “IFRS Practice, Comparison with French Rules and US GAAP”, Dunod, 2004.
2. Daniel Boeri, Mastering Quality: Everything About Certification and Total Quality, Editions Maxima, 2003, p. 26. (ISBN 2840013134)
3. ISO 9000:2015 Standard “Quality management system – Fundamentals and vocabulary”
4. Standard, ISO 9001:2015 “Quality Management System – Requirements” https://fr.wikipedia.org/wiki/S%C3%A9rie_des_normes_ISO_9000
5. Appendix D: authorization, recycling, ED6127 reference: general training and recycling plan to the authorization in the nfc18510_inrs_habilitation standard.
6. 2014 Catalogue of Algerian Standards PDF document 447 pages (free download) http://www.ianor.dz/Site_IANOR/Catalogue.php?id=8
7. List of Organizations accredited by Algerac: certification, inspection, testing-analysis, etc. (updated 09/14/2017)

Semester: 5

Teaching unit: UED 3.1

Subject 2: Renewable Energies: Production and storage

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 1

Coefficient: 1

Teaching objectives:

This course allows the student to understand 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

Content of the material:

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

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

Chapter 3. Main sources of electrical energy production Fossil and renewable. **(3 Weeks)**

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

Chapter 5. Autonomous energy sources with storage systems **(4 Weeks)**
Batteries, capacitors, others.

Assessment method:

Review: 100%.

Bibliographic references:

1. Jean-Christian Lhomme, Alain Liébard, “Renewable Energies”, Delachaux & Niestlé, Edition: 2nd edition, 2004.
2. Leon Freris and David Infield, “Renewable Energies for Electricity Production,” Dunod, 2013.
3. Philippe Terneyre, “Renewable energies: Implementation contracts: Implementation of units of production, suspensive clauses, contract models”, Sa Lamy, April 2010.
4. Michel Lavabre and Fabrice Baudoin, “Energy Conversion Exercises and Problems: Volume 5, Energies renewables (1): wind turbines, energy management and storage”, Casteilla, 2010.

Semester: 5

Teaching unit: UET 3.1

Subject 1: Simulation software

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 1

Coefficient: 1

Teaching objectives:

Know simulation software, be able to reproduce an electro-energetic system for its study and simulation.

Recommended prior knowledge: Programming concepts, Matlab concepts.

Content of the material:

Chapter 1: Getting Started with MATLAB (02 weeks)

1.1 - Introduction

1.2 - MATLAB Environment

1.3 - Starting MATLAB

Command window, Defined variables window (the workspace), Working Directory Window, Command History Window

1.4 - Presentation and general information

Getting Help, Getting Started, The Workspace, One-Line Syntax, Managing Working Directory Files, Arithmetic Operations, Scalar Operations and Functions, Special Variables and Constants, Number Format and Calculation Precision, Command History

Chapter 2: Data Types and Variables (02 weeks)

2.1 - Data types

2.2 - Variables

Complex numbers, Boolean variables, Strings, Vectors, Matrices, Polynomials.

Chapter 3: Graphs (01 week)

3.1 - Managing graphical windows

3.2 - 2D graphical representation

Cartesian coordinate charts, Improving the readability of a figure, Polar coordinate charts, Diagrams.

3.3 - 3D graphics

3D Curves, Surfaces

Chapter 4: Programming in MATLAB 4.1 - (02 weeks)

Arithmetic and Logical Operators and Special Characters

4.2 - M-Files

4.3 - Scripts and functions

(Scripts, Functions)

4.4 - Control instructions

(FOR Loop, WHILE Loop, The Conditional IF 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 start

5.3 - Masks and Subsystems
5.2.1 - Subsystems
5.3.2 - Masking Subsystems Masking
the Subsystem, Using Callbacks
5.4 - Study of some simulation examples

Chapter 6: Power System Blockset (PSB) (2 weeks)

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

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

7.1 - Simulation by PSim and Simulink-PSim co-simulation
7.2 - Simulation with other software: PSpice, Proteus, Scilab,….

Assessment method:

Review: 100%.

Bibliographic references:

1. A. Lanton, “Methods and tools of simulation”, Edition, Hermès, 2000.
2. Matlab online documentation

Semester: 6

Teaching unit: UEF 3.2.1

Subject 1: Sampled servo systems

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4

Coefficient: 2

Teaching objectives:
Know the techniques of sampling and signal reconstruction, Be able to study the stability and evaluate the precision of a sampled servo system, Apply some methods of analysis and synthesis of sampled servo systems.

Recommended prior knowledge: Linear and continuous servo systems, Basic mathematics (Algebra, analysis, etc.).

Content of the material:

Chapter 1. Structure of a numerical control system (1 Week)
History, Advantages and disadvantages of digital control, General structure of a digital control system, A/D and D/A conversions, Sample/hold devices.

Chapter 2. Signal Sampling (2 Weeks)
Modeling of A/D and D/A Converters, Sampling, Signal Reconstruction, Blockers, Z-transmittance and frequency response of a BOZ (zero-order blocker), Shannon sampling theorem, Practical considerations.

Chapter 3. Representation of sampled systems (3 Weeks)
Definitions, Representation by difference equations, Lead/lag operators, Representation by impulse response, Z transform, Z transmittance and simplification of blocks/diagrams, Pole/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 Locus).

Chapter 5. Synthesis of sampled systems (4 Weeks)
Introduction, Speed, Static Accuracy, Standard PID Controllers, P-Plane Synthesis and Digitization, Z-Plane Synthesis, Practical Implementation of Controllers.

Chapter 6. RST Controller (1 Week)

Assessment method:
Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. JR Ragazzini, GF Franklin, “Sampled servo systems”, Dunod, 1962.
2. Daniel Viault, Yves Quenec'hdu, “Sampled servo systems”, ESE, 1977.
3. Christophe Sueur, Philippe Vanheeeghe, Pierre Borne, “Automation of sampled systems: course elements and solved exercises”, Technip, December 5, 2000.
4. P. Borne. GDTanguv. JP Richard. F. Rotella, I. Zambetalcis, “Analysis and regulation of industrial processes-digital regulation”, Volume 2-Editions Technip, 1993.
5. Emmanuel Godoy, Eric Ostertag, “Digital control of systems: Frequency and polynomial”, Ellipses Marketing, 2004.

Semester: 6

Teaching unit: UEF 3.2.1
Subject 2: Actuators

VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4

Coefficient: 2

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

Recommended prior knowledge: Power electronics,
Fundamental electronics 1, Fundamental electrical engineering 1.

Content of the material:

Chapter 1: Reminders **(2 Weeks)**

Reminders: Operating parts and control of an automated system, Structure of an automation in pneumatic, electrical, electronic technologies
Interfaces: Interfaces that modify the parameters of a signal; Interfaces that modify the nature of a signal

Chapter 2- Pneumatic Actuator: The Cylinder 1- **(2 Weeks)**
Description. 2-Dimensioning. 3-End of stroke sensors. 4-Different types of cylinders. 5-Application example

Chapter 3- Precautions for pneumatic actuator: The distributor (2 Weeks)
1-Means of control or control. 2-Standardized symbols. 3-Electro distributors. 4-Distribution auxiliaries. 5-Example of application.

Chapter 4- Electric Actuator: The Motor 1- Direct **(3 Weeks)**
current motor. 2- Single-phase motor. 3- Stepper motor. 4- Three-phase asynchronous motor.

Chapter 5- Precautionary measures for electric actuators **(2 Weeks)**
1-Manually controlled switching device: the circuit breaker and the motor circuit breaker. 2-Automatically controlled switching device: the contactor. 3-Electronically controlled switching device: the electronic speed controller.

Chapter 6 - Reminders: the motor in an electrical installation 1- **(1 Week)**
Single-phase and three-phase power supply network. 2-Functional structure of an electrical installation (power and control parts and the different functions). 3-Sectioning or isolation function of the installation (the disconnector). 4-Protection of the power circuit (against short circuits, overcurrents, overloads). 5-Switching function. 6-Protection of the control circuit.

Chapter 7- Three-phase motor control 1- **(3 Weeks)**
Stator coupling (star, delta). 2- Rotor coupling (cage or short-circuit, wound rotor).
3-Starting modes (direct, star-delta, stator resistances, rotor resistances). 4-
Braking of three-phase asynchronous motors. 5-Different types of control (manual, semi-automatic, automatic). 6- Example of summary: 1 - Semi-automatic control -2- Automatic control by PLC.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. Guy Clerc, Guy Grellet, “Electric actuators, models, control”, Eyrolles, 1999.
2. Gérard Lacroux, “Electric actuators for robotics and servocontrol”, 1994.
3. Pierre Mayé, Industrial electric motors, Dunod, 2011.
4. J. Faisandier, “Hydraulic and pneumatic mechanisms”, Dunod 1999.
5. R. LABONVILLE, “Design of hydraulic circuits, an energy approach”, Editions de l'Ecole Polytechnique de Montréal 1991.
6. P. MAYE, “Electric motors for robotics”, Dunod Paris 2000.
7. José RoldanViloria, Industrial Pneumatics Reference Guide, Dunod, 2015.

Semester: 6

Teaching unit: UEF 3.2.1

Subject 3: Sensors and measuring chains

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 2

Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge: General

Electricity, Electrical and Electronic Measurements.

Content of the material:

Chapter 1. Notions of measurement chain: (1 Week)

Definition, synopsis of an industrial regulation chain, active and passive sensors, classification of sensors.

Chapter 2. Metrological characteristics of sensors: (1 Week)

Definition, calibration of a sensor, sensitivity, linearity, precision, dynamic sensitivity.

Chapter 3. Sensor conditioning circuit: (3 Weeks)

Basic assemblies of operational amplifiers (inverting, non-inverting, differential, summing, etc.). Instrumentation amplifier, isolation amplifier. Conditioning bridges. Linearization of static characteristics of sensors.

Chapter 4. Temperature measurement: (3 weeks)

Introduction to thermometry, Resistance thermometry, Thermocouple, Thermistor, Pyrometer.

Chapter 5. Pressure measurement: (2 weeks)

Concepts of pressure, absolute pressure, relative pressure and differential pressure. Piezoresistive pressure sensors

Chapter 6. Level and flow measurement: (3 weeks)

Float sensors, Doppler effect ultrasonic sensors **Chapter**

7. Displacement and speed measurement: Optical **(2 weeks)**

encoders, Incremental encoders, Variable reluctance sensors.

Assessment method:

Review: 100%.

Bibliographic references:

1. George Asch et Coll, “Sensors in industrial instrumentation”, 6th edition Dunod, 2006.
2. Pascal Dassonvalle, “Sensors: 50 exercises and corrected problems”, Dunod, 2004.
3. Georges Asch, Patrick Renard, Pierre Desqoutte, Zoubir Mammeri, Eric Chambérod, Jean Gunther, “Data Acquisition”, 3rd edition, Dunod, 2011.
4. FèridBélaïd, “Introduction to sensors in industrial instrumentation”, Publication Center University 2006.
5. JP Bentley, “Principles of measurement systems”, Pearson education 2005.
6. J. Niard et al, “Electrical measurements”, Nathan, 1981.

Semester: 6

Teaching unit: UEF 3.2.2

Subject 1: Industrial programmable controllers

VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)

Credits: 6

Coefficient: 3

Teaching objectives:

Identify the technological elements enabling the operation and monitoring of an automated production system to be controlled,
Use the specification tools for industrial automation in order to predict a cycle time or a production rate.

Recommended prior knowledge: Basic knowledge of calculators and programming.

Content of the material:

Chapter 1. General information on automated systems **(2 weeks)**

Description of the different parts, Different types of control, Areas of application of automated systems.

Chapter 3. The Grafcet (3 weeks)

Description of Grafcet, Rules for Grafcet evolution, Basic structures, Start and stop modes.

Chapter 4. API Architecture (3 weeks)

PLC Technology, PLC Environment, External Appearance, Internal Structure, Criteria and Choice of PLCs, Wiring of the PLC to the Different I/Os and Interfaces of an SAP (Automated Production System)

Chapter 5. Programming a PLC (7 weeks)

PLC program processing and execution cycles, Different programming languages (Ladder or contact, Boolean or logic or List Mode, graphic or Logic Chart, SFC or Grafcet), single sequence Grafcet programming, multiple sequence Grafcet programming.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. Hamdi Hocine, “Logical automation: modeling and control”, volumes 1 and 2, UMC editions, 2006.
2. William Bolton, “Programmable industrial automatons”, Dunod, 2010.
3. JC Humblot, “Industrial Programmable Automation”, Hermes Science Publications, 1993.
4. Simon Moreno, Edmond Peulot, “GRAFCET: design, implementation in industrial programmable automatons”, Delagrave, 2009.
5. Kevin Collins, “Programming Industrial Programmable Logic Controllers,” Meadow Books, 2007.
6. G. Michel, “AP I: architecture and applications of industrial programmable automatons”, Dunod, 1988.

Semester: 6

Teaching unit: UEF 3.2.2
Subject 2: Communication buses and industrial networks

VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 2

Coefficient: 1

Teaching objectives:

The aim of this course is to enable students to become familiar with the concepts of digital data transmission, particularly the different types of networks that exist in the industrial world. Emphasis will be placed on understanding the different topologies and their advantages and disadvantages for a given industrial installation.

Recommended prior knowledge: Basic notions of Boolean logic.

Content of the material:

Chapter 1. Network Architecture ÿGeneralities on Networks **(2 Weeks)**
ÿNetwork classification
ÿNetwork topologies
ÿCommunication protocols ÿData transmission techniques

Chapter 2. Fieldbuses and industrial local area networks **(3 weeks)**
ÿ Industrial local networks
ÿ Objectives of field buses ÿ Classification of field buses

Chapter 3. CAN (Controller Area Network) Bus ÿClassification of CAN buses. ÿCAN communication protocols ÿRepresentation of CAN frames **(3 Weeks)**

Chapter 4: Actuator-sensor interface (AS-I) ÿArchitecture of an AS-I fieldbus **(3 weeks)**
ÿAS-I communication protocols

Chapter 5. ProfiBus Field Networks ÿClassification of ProFiBus Networks **(4 weeks)**
ÿProfibus and OSI model (communication protocols)
ÿ Principle of bus access in a Profibus network

Assessment method:

Review: 100%.

Bibliographic references:

1. Pascal Vrignat, “Local industrial networks - Courses and practical work”, 1999.

2. Jean-François Hérold, Olivier Guillotin, Patrick Anaya, “Industrial computing and networks”, Dunod 2010.

3. Eric DECKE, “Course module, Industrial Local Networks and Field Buses”, photocopy.

4. Tanenbaum, Andrew, “Networks”, Dunod 4th edition 2003.

5. Stéphane Lohier, Dominique Présent, “Transmissions and networks”, Éditions DUNOD 6. Francis Lepage et al, “Local industrial networks”, Hermes 1991.

7. Fred Halsal, “Mutimedia Communications: Applications, Networks, Protocols and Standards”, AddisonWesley, 2001. 8.

http://lysjack.free.fr/jack/RLI.htm.

Semester: S6

Teaching unit: UEM3.2

Subject 1: End of cycle project

VHS: 45h00 (TP: 3h00)

Credits: 4

Coefficient: 2

Teaching objectives:

Assimilate knowledge from different subjects in a comprehensive and complementary manner. Put into practice the concepts taught during training. Encourage students' sense of autonomy and initiative. Teach them to work in a collaborative environment by stimulating their intellectual curiosity.

Recommended prior knowledge: The entire Bachelor's program.

Content of the material:

The theme of the End of Cycle Project must come from a joint choice between the tutor and a student (or a group of students: pairs or even trios). The substance of the subject must necessarily fit with the objectives of the training and the real skills 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.

Noticed :

During the weeks when students are familiarizing themselves with the purpose of their project and its feasibility (bibliographic research, search for software or hardware necessary to carry out the project, revision and consolidation of teaching directly related to the subject, etc.), the subject manager must use this face-to-face time to remind students of the essential content of the two subjects "Writing Methodology" and "Presentation Methodology" covered 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 must set out as explicitly as possible:

- The detailed presentation of the study theme, emphasizing its interest in its socio-economic environment.
- The means implemented: methodological tools, bibliographic references, contacts with professionals, etc.
- Analysis of the results obtained and their comparison with the initial objectives.
- Criticism of the observed deviations 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 the work carried out.

The student or group of students finally presents their work (in the form of a brief oral presentation or on a poster) in front of their tutor and an examiner who can ask questions and thus assess the work accomplished in terms of technique and presentation.

Assessment method:

Continuous assessment: 100%.

Semester: 6

Teaching unit: UEM 3.2 Subject 2:

Practical work on Sensors and Actuators

VHS: 10:30 p.m. (practical work: 1:30 p.m.)
Credits: 2

Coefficient: 1

Teaching objectives: These practical exercises allow students to use and master the theoretical concepts studied during the course. Teachers must choose four practical exercises suitable for each subject.

Recommended prior knowledge: Sensors and measuring chains, Actuators.

Content of the material:

TP Sensors

TP1: Conditioning of sensors

TP2: Temperature measurement

TP3: Pressure measurement

TP4: Level and flow measurement

TP5: Photometric measurement

TP6: Measurement of rotation speed

TP Actuators

TP1: Implementation of a pneumatic system

TP2: Control valve

TP3: Stepper motor

TP4: Direct current and alternating current motor

TP5: Three-phase motor

Assessment method:

Continuous assessment: 100%.

Semester: 6

Teaching unit: UEM 3.2.1

Subject 3: Practical work on industrial programmable controllers

VHS: 10:30 p.m. (TP: 1:30)

Credits: 2

Coefficient: 1

Teaching objectives:

Once this material has been acquired, the student will be able to understand and implement a basic automated system. Through the various manipulations, he will be able to program a programmable automaton to intelligently manage and coordinate the actions provided for in the specifications that will be presented to him.

Recommended prior knowledge: Industrial Programmable Controllers course.

Content of the material:

Plan some practical work related to the available industrial programmable controllers.

Assessment method:

Continuous assessment: 100%.

Semester: 6

Teaching unit: UEM 3.2.1 Subject 4:
Practical work Communication buses and industrial networks

VHS: 10:30 p.m. (TP: 1:30)
Credits: 1

Coefficient: 1

Teaching objectives: The aim 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 lines.

Recommended prior knowledge:
Course on communications buses and industrial networks.

Content of the material:

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

Assessment method:
Continuous assessment: 100%.

Semester: 6

Teaching unit: UED 3.2

Subject 1: Automatic electrical installations

VHS: 10:30 p.m. (Class: 1.5 hours)

Credits: 1

Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge: General

electricity, continuous servo systems, fundamental electrical engineering1.

Content of the material:

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

Chapter 2. Standardized electrical equipment and connection diagrams (6 Weeks)

Internal overpressure “p”, explosion-proof enclosure, protective devices, control devices, use of sensors, standardized symbols, electrical connection of controllers to actuators, creation of electrical assemblies.

Chapter 3. Instrument Wiring (4 Weeks)

Connections between the different elements of the control system, standardized cables, instrumentation cables, safety cables and wiring.

On-site visits (which can be found everywhere) will be welcome to supplement the student's training in this very important subject from a practical perspective. These visits could be incorporated into the timetable.

Assessment method:

Review: 100%.

Bibliographic references:

Michel Grout and Patrick Salaun, “Industrial Instrumentation”, 3rd edition, DUNOD, 2012.

Semester: 6

Teaching unit: UED 3.2
Subject 2: Maintenance and reliability

VHS: 10:30 p.m. (Class: 1.5 hours)
Credits: 1

Coefficient: 1

Teaching objectives:

Know the basic concepts of maintenance and operational safety, become familiar with maintenance methods.

Recommended prior knowledge: Sensors and measuring chains, actuators.

Content of the material:

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 abacus, decision tree, criticality matrix, correlation relationships.

Chapter 4. The Diagnosis (4 Weeks)
Definition and methodology, conduct of the diagnosis, diagnostic tools (cause and effect table, fault tree, diagnostic diagram, etc.), comparative study of the tools.

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

Assessment method:

Review: 100%.

Bibliographic references:

1. Jean HENG, “Practice of preventive maintenance”, Dunod, 2002.
2. Renaud CUIGNET, “Maintenance Management”, Dunod, 2002.
3. Introduction to TPM, USINOR, Quality and Management Institute, 1997.
4. “Practice of autonomous maintenance”, USINOR, Quality and Management Institute 1997.
5. F. MONCHY, Maintenance: methods and organization, Dunod, 2000.
6. JM BLEUX, JL FANCHON, Maintenance: automated production systems, Etapes Collection, Nathan, 1997.

Semester: 6

Teaching unit: UET 3.2 Subject 1:

Entrepreneurship, Start-Up VHS: 10:30 p.m.

(Course: 1:30 p.m.)

Credits: 1

Coefficient: 1

Course Objectives: This course aims to introduce students to the fundamentals of entrepreneurship, startup creation, and innovation processes. It will enable students to acquire the skills necessary to identify innovative opportunities, develop a viable business concept, and understand the essential steps involved in creating a startup.

Content of the subject:

Chapter 1: Introduction to entrepreneurship • Definition and interrelation 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** • Identification of opportunities • Creativity techniques (brainstorming, mind mapping, etc.) • Case study: failure vs. success **(2 weeks)**

Chapter 2: Identification of innovative opportunities • Methods for detecting innovation opportunities • Analysis of unmet needs in the Algerian market • Design thinking and user-centered approach • Creativity and ideation techniques **(1 week)**

Chapter 3: Business Model Canvas • Components of the Business Model Canvas • Development of the value proposition • Customer segmentation • Distribution channels and customer relations • Cost structure and revenue sources • Development of disruptive economic models **(3 weeks)**

Chapter 4: Introduction to the Business Plan • Structure and key elements of the business plan • Simplified market research • Marketing and sales strategy • Fundamental financial aspects • SWOT analysis • Marketing plan, operational plan **(2 weeks)**

Chapter 5: Financing start-ups • Sources of financing available in Algeria **(3 weeks)**

- Public entrepreneurship support schemes (ANSEJ, incubators, accelerators, CNAC, ANGEM)
- Venture capital and business angels
- Crowdfunding
- Protection of intellectual property
- Tax benefits and specific support for innovative start-ups

Chapter 6: Communication and Leadership (1 week)

- Oral presentation techniques
- Teamwork, conflict management

Chapter 7: Legal and administrative aspects • (1 week)

Legal forms of companies in Algeria

- Administrative procedures for creation
- Protection of intellectual property
- Taxation of start-ups

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

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

Assessment method: 100% exam

Bibliographic references:

1. Christensen, CM (2021). The Innovator's Dilemma: When New Technologies Cause Big Companies to Fail. VALOR.
2. Nezha DA, Mouffok B. (2023). Startups and Entrepreneurship The Future of Algeria European University Editions.
3. Osterwalder, A., & Pigneur, Y. (2011). *Next Generation Business Model: A Guide for Visionaries, Revolutionaries and Challengers.* Pearson.

1. Fayolle, A. (2012). *Entrepreneurship: Learning to undertake.* Dunod.
2. Blank, S., & Dorf, B. (2013). *The Startup Founder's Handbook: Step by Step, Build a great business.* Diateino.
3. Ries, E. (2015). *Lean Startup: Embrace Continuous Innovation.* Pearson.
5. Madoui, M. (2015). *Maghreb Entrepreneurs: Lands in Development.* Karthala.
6. Grim, N. (2012). *Entrepreneurs, Business Creation and Development.* Editions European universities.

IV- Agreements / Conventions

STANDARD LETTER OF INTENT

(In case of a license co-sponsored by another university establishment)

(Official paper on the letterhead of the university establishment concerned)

Subject: Approval of co-sponsorship of the license entitled:

The above-mentioned university (or university center) declares co-sponsorship of the hereby grants the license for the entire period of authorization of the license.

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

- Giving his point of view in the development and updating of teaching programs,

- Participant in seminars organized for this purpose,
- By participating in the defense juries,
- By working to pool human and material resources.

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

STANDARD LETTER OF INTENT

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

(Official company letterhead)

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

Provided to:

The company hereby provides declares his will to demonstrate his 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:

- Give our point of view in the development and updating of programs teaching,
- Participate in seminars organized for this purpose,
- Participate in defense juries,
- Facilitate as much as possible the reception of interns either within the framework of theses or end of studies, or within the framework of supervised projects.

The means necessary to carry out the tasks incumbent upon us to achieve these objectives will be implemented on a material and human level.

Mr (or Mrs)*…….is designated as external coordinator of this project.

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

OFFICIAL STAMP or COMPANY SEAL

V - Opinions and Visas of the Administrative and Consultative Bodies

License Title: Automatic

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

VI – Notice and Visa of the Regional Conference

VII – Opinion and Visa of the National Educational Committee of the Domain