TRAINING OFFER
L.M.D.

ACADEMIC LICENSE

NATIONAL PROGRAM
2025 – 2026
(3rd update)

Establishment	Faculty / Institute	Department

Domain	Sector	Speciality
Science and Technology	*Electrotechnical*	*Electrotechnical*

عرض تكوين
ل. م . د

ليسانس أكاديمية

برنامج وطني
2026 – 2025

القسم	الكلية/ المعهد	المؤسسة

التخصص	الفرع	الميدان
كهروتقني	كهروتقني	علوم و تكنولوجيا
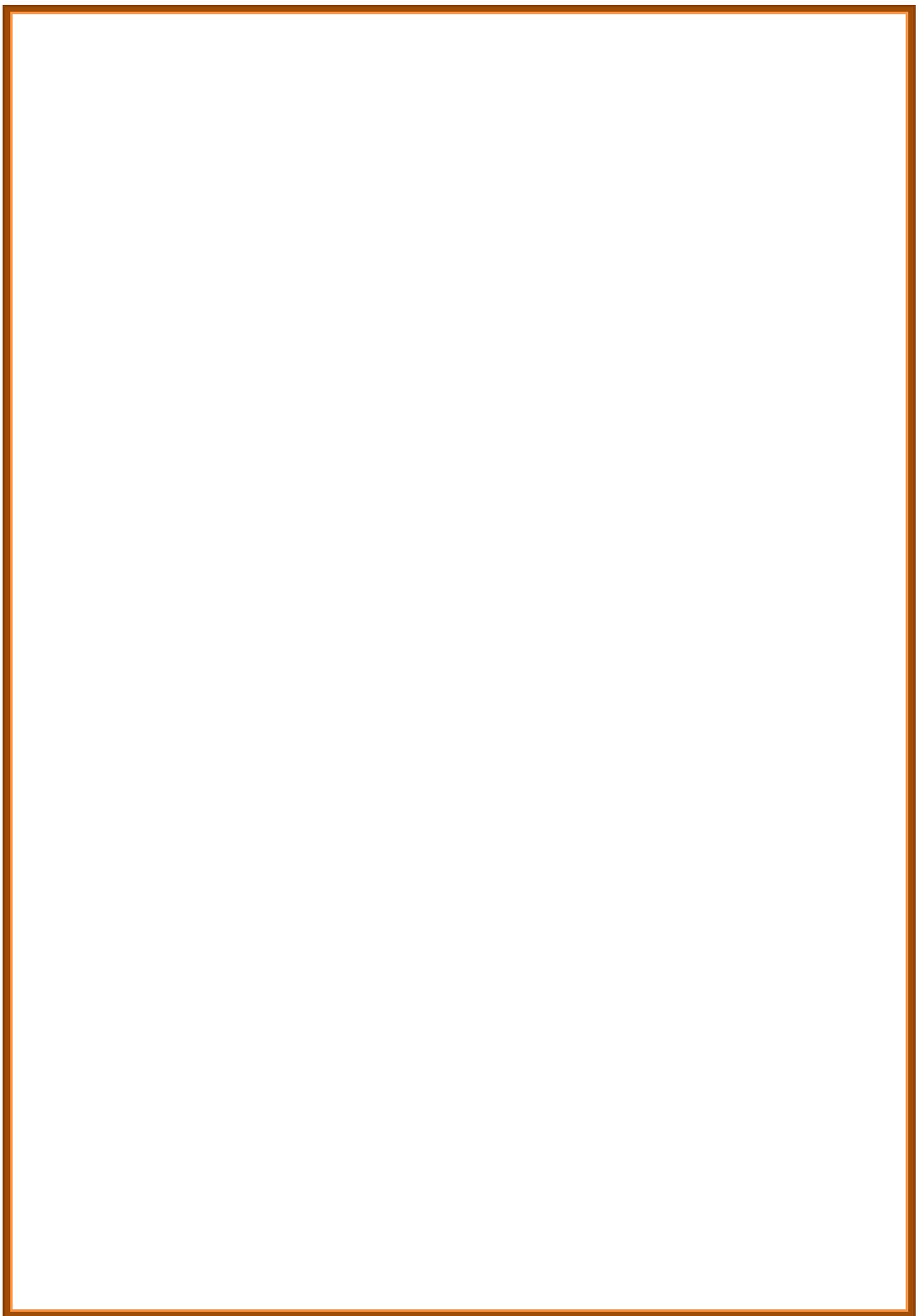
II – Half-yearly organization sheets for the specialty courses

Semester 1

Teaching unit	module / Titled	Credits	Coefficient	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
				Course	TD	PW			Continuous Control	Exam
UE Fundamental **Code : UEF 1.1.1** **Credits : 10** **Coefficients : 5**	Analysis 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Algebra 1	4	2	3h00	1h30		45h00	55h00	40%	60%
UE Fondamentale **Code : UEF 1.1.2** **Credits : 12** **Coefficients : 6**	Elements of mechanics	6	3	1h30	3h00		67h30	82h30	40%	60%
	Structure of matter	6	3	1h30	3h00		67h30	82h30	40%	60%
UE Méthodologique **Code : UEM 1.1** **Credits : 6** **Coefficients : 4**	PW Elements of mechanics	2	1			1h30	22h30	22h30	100%	
	PW Structure of matter	2	1			1h30	22h30	22h30	100%	
	Computer Structure and Applications	2	2	1h30		1h00	37h30	22h30	40%	60%
E Transverse **Code : UET 1.1** **Credits : 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**	**4h00**	**375h00**	**375h00**		

Semestre 2

Teaching unit	module Titled	Credits	Coefficient	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
				Course	TD	PW			Continuous Control	Exam
UE Fundamental Code : UEF 1.2.1 Credits : 10 Coefficients : 5	Analysis 2	6	3	1h30	3h00		67h30	82h30	40%	60%
	Algebra 2	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fondamental Code : UEF 1.2.2 Credits : 12 Coefficients : 6	Electricity and magnetism	6	3	1h30	3h00		67h30	82h30	40%	60%
	Thermodynamics	6	3	1h30	3h00		67h30	82h30	40%	60%
UE Methodology Code : UEM 1.2 Credits : 6 Coefficients : 4	PW Electricity and magnetism	2	1			1h30	22h30	22h30	100%	
	PW Thermodynamics	2	1			1h30	22h30	22h30	100%	
	Introduction to programming	2	2	1h30		1h00	37h30	22h30	40%	60%
UE Transverse Code : UET 1.2 Credits : 2 Coefficients : 2	Free and open source software	2	2	1h30	1h30		45h00	05h00	40%	60%
Total semester 2		30	17	9h00	10h30	5h30	375h00	375h00		

Semestre 3

Teaching unit	module / Titled	Credits	Coefficient	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
				Course	TD	PW			Continuous Control	Exam
UE Fundamental Code : UEF 2.1.1 Credits : 10 Coefficients : 5	Analysis 3	6	3	1h30	3h00		67h30	82h30	40%	60%
	Waves and vibrations	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fondamentale Code : UEF 2.1.2 Credits : 8 Coefficients : 4	Fundamental Electronics 1	4	2	1h30	1h30		45h00	55h00	40%	60%
	Fundamental Electrotechnics 1	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Methodology Code : UEM 2.1 Credits : 10 Coefficients : 6	Probability and statistics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Python Programming	2	2	1h30		1h30	45h00	30h00	40%	60%
	PW of Electronics and Electrotechnics	2	1			1h30	22h30	22h30	100%	
	PW Waves and Vibrations	2	1			1h00	15h00	15h00	100%	
UE Discovery Code : UED 2.1 Credits : 2 Coefficients : 2	Energy and the environment	1	1	1h30			22h30	02h30		100%
	State of the art in electrical engineering	1	1	1h30			22h30	02h30		100%
Total semester 3		**30**	**17**	**12h00**	**9h00**	**4h00**	**375h00**	**375h00**		

Semestre 4

| Teaching unit	module Titled	Credits	Coefficient	Weekly hourly volume Course	TD	PW	Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method Continuous Control	Exam
UE Fundamental Code : UEF 2.2.1 Credits : 10 Coefficients : 5	Fundamental Electrical Engineering 2	6	3	1h30	3h00		67h30	82h30	40%	60%
	Combinational and sequential logic	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 2.2.2 Crédits : 6 Coefficients : 3	Signal Theory	4	2	1h30	1h30		45h00	55h00	40%	60%
	Production de l'énergie électrique	2	1	1h30			22h30	22h30		100%
UE Methodology Code : UEM 2.2 Credits : 13 Coefficients : 7	Numerical methods	5	3	1h30	1h30	1h30	67h30	82h30	40% (20%TD+20%TP)	60%
	Electrical and electronic measurements	3	2	1h30		1h00	37h30	37h30	40%	60%
	PW Fundamental Electrotechnics 2	2	1			1h30	22h30	17h30	100%	
	PW Combinational and Sequential Logic	2	1			1h30	22h30	17h30	100%	
UE Transverse Code : UET 2.2 Credits : 2 Coefficients : 2	Information and communication technologies	2	2	1h30	1h30		22h30	02h30	40%	60%
Total semester 4		**30**	**17**	**10h30**	**7h30**	**7h00**	**375h00**	**375h00**		

Semestre 5

Teaching unit	module	Credits	Coefficien	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			Course	TD	PW			Continuous Control	Exam
UE Fundamental Code : UEF 3.1.1 Credits : 10 Coefficients : 5	Electrical Networks	6	3	1h30	3h00		67h30	82h30	40%	60%
	Power Electronics	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 3.1.2 Credits : 8 Coefficients : 4	Controlled Systems	4	2	1h30	1h30		45h00	55h00	40%	60%
	Electromagnetic Field Theory	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Methodology Code : UEM 3.1 Credits : 9 Coefficients : 5	Electrical Diagrams and Equipment	3	2	1h30		1h00	37h30	37h30	40%	60%
	PW Electrical Networks	2	1			1h30	22h30	27h30	100%	
	PW Power Electronics	2	1			1h30	22h30	27h30	100%	
	PW Servo Systems/PW Sensors	2	1			1h30	22h30	27h30	100%	
UE Discovery Code : UED 3.1 Credits : 2 Coefficients : 2	Sensors and Metrology	1	1	1h30			22h30	02h30		100%
	Electrical Safety	1	1	1h30			22h30	02h30		100%
UE Transverse Code : UET 3.1 Credits : 1 Coefficients : 1	Simulation software	1	1	1h30			22h30	02h30		100%
Total semester 5		**30**	**17**	**12h00**	**7h30**	**5h30**	**375h00**	**375h00**		

Semestre 6

Teaching unit	module Titled	Credits	Coefficient	Weekly hourly volume Course	Weekly hourly volume TD	Weekly hourly volume PW	Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Continuous Control	Examen
UE Fundamental Code : UEF 3.2.1 Credits : 10 Coefficients : 5	Control of electrical machines	6	3	1h30	3h00		67h30	82h30	40%	60%
	Industrial regulation	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 3.2.2 Credits : 8 Coefficients : 4	Industrial Automation	4	2	1h30	1h30		45h00	55h00	40%	60%
	Materials and Introduction to High Voltage	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Methodology Code : UEM 3.2 Credits : 9 Coefficients : 5	Final Year Project	4	2			2h30	37h30	42h30	100%	
	PW Machine control	1	1			1h30	22h30	22h30	100%	
	PW Industrial regulation	2	1			1h30	22h30	27h30	100%	
	PW Automation/ PW Materials and HT	2	1			1h30	22h30	27h30	100%	
UE Descovery Code : UED 3.2 Credits : 2 Coefficients : 2	Protection of electrical networks	1	1	1h30			22h30	02h30		100%
	Industrial Maintenance	1	1	1h30			22h30	02h30		100%
UE Transverse Code : UET 3.2 Credits : 1 Coefficients : 1	Entrepreneurship and start-ups	1	1	1h30			22h30	02h30		100%
Total semester 6		**30**	**17**	**10h30**	**10h30**	**7h00**	**375h00**	**375h00**		

Récapitulatif global de la formation :

UE / VH	UEF	UEM	UED	UET	Total
Course	720h00	142h30	225h00	180h00	1267h30
TD	495h00	22h30	---	---	517h30
TP	---	465h00	---	---	465h00
Personal work	1485h00	720h00	25h00	20h00	2250h00
Other (specify)	---	---	---	---	---
Total	2700h00	1350h00	250h00	200h00	4500h00
Credits	108	54	10	8	180
% in credits for each UE	60 %	30 %	10 %		100 %

Teaching unit credits
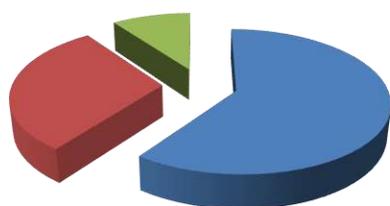
- Unités Fondamentales 60%
- Unités méthodologiques 30%
- Unités de découverte et transversales 10%

Hourly volume of face-to-face time
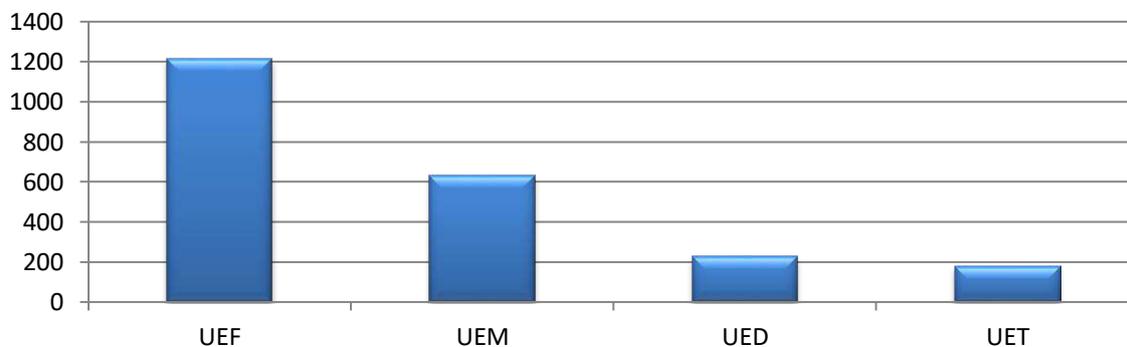
Total hourly volume
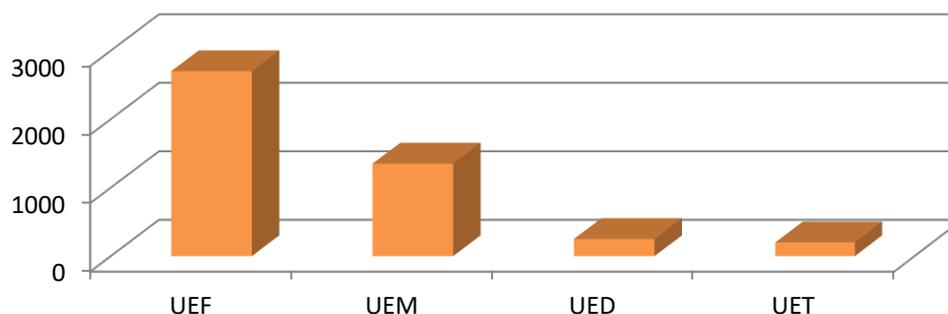
III - Detailed program by subject

Teaching objectives
This first analysis subject is particularly dedicated to standardizing the level 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.

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

Content of the material:

Chapitre 1 : Properties of the set R

1. Increased, decreased and bounded part.
2. Maximum element, minimum element.
3. Upper limit, lower limit.
4. Absolute value, integer part.

Chapter 2: Real Numerical Sequences
1. Convergent sequences.
2. Comparison theorems.
3. Monotone convergence theorem.
4. Subsequences.
5. Adjacent sequences.
6. Special sequences (arithmetic, geometric, recursive)

Chapter 3: Real Functions of 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 expansion
2. Taylor's formula
3. Limited expansion of functions

Chapter 5: Simple Integrals

1. Review of the Riemann integral and the calculation of antiderivatives.

Assessment Method:
Continuous Assessment: 40%; 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, Algèbre : Classes préparatoires et Université Tome 1, Exercices avec solutions, Vuibert.
   3- N. Faddeev, I. Sominski, Collection of Higher Algebra Exercises, Moscow Edition

Teaching objectives

This first analysis subject is particularly dedicated to standardizing the level 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.

Subject Content:

Chapter 1. Sets, Relations, and Mappings   (5 weeks)

1. Set Theory
2. Order Relations, Equivalence Relations
3. Injective, Surjective, and Bijective Mappings and Inverse Functions: Definition of a mapping, direct image, inverse image, characteristic of a mapping.

Chapter 2: Complex Numbers   (5 weeks)

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

Chapter 3: Vector Spaces   (5 weeks)

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

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Bibliographic references:

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

Teaching Objectives

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

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

Recommended Prior Knowledge

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

Course Content:

Chapter 1: Reminder

Chapter 2: Kinematic

Chapter 3: Dynamic

Chapter 4: Rotational movement

Chapter 5: Work, power, energy

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Course Objectives

Teaching this subject allows students to acquire basic chemical formalisms, particularly those describing the atom and chemical bonding, chemical elements, and the periodic table with energy quantization. It also aims to equip students with the skills to solve chemical problems.

Recommended Prior Knowledge

Basic concepts of mathematics and general chemistry.

Course Content:

Chapter 1: Fundamental Concepts   **(2 Weeks)**

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

Chapter 3: Radioactivity – Nuclear Reactions   **(2 Weeks)**

Chapter 4: Electronic Structure of the Atom   **(2 Weeks)**

Chapter 5: Periodic Table of Elements   **(3 Weeks)**

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

Assessment Method:

Continuous Assessment: 40%;   Exam: 60%.

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

Semester: 1
Teaching unit : UEM 1.1.1
matter 2: PW Mechanical Element
VHS: 22H30 (PW: 3h00)
Credits: 2
Coefficient: 1

Course Objectives

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

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

Recommended Prior Knowledge
It is recommended to have a good grasp of physical sciences and basic mathematics in secondary school

Course Content:

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

Assessment Method:
Continuous Assessment: 100%

Objective and Recommendations:

Teaching this subject allows students to acquire basic chemical formalisms, particularly those describing the atom and chemical bonding, chemical elements, and the periodic table with energy quantization. It also aims to equip students with the skills to solve chemical problems.

Recommended Prior Knowledge:

Basic concepts of mathematics and general chemistry.

Subject Content:

PW 1: Preliminary Lab: Safety in the Chemistry Laboratory and Description of Equipment and Glassware.

PW 2: Change of State of Water: Transition from Liquid to Solid and from Liquid to Vapor.

PW 3: Determination of the Amount of Substance.

PW 4: Determination of Molecular Mass.

PW 5: Uncertainty Calculation - Determination of Ionic Radius.

PW 6: Determination of Partial Molar Volumes in a Binary Solution.

PW 7: Qualitative Analysis of Cations (Groups 1, 2, 3, and 4).

PW 8: Qualitative Analysis of Anions.

PW 9: Identification of Metal Ions by the Flame Method.

PW 10: Separation and Recrystallization of Benzoic Acid. Lab 11: Construction and study of some compact structures.

PW 11: Study of ionic structures.

Assessment Method:

Continuous Assessment: 40%;   Exam: 60%.

Bibliographical references:

1. Ouahes, Devallez, Chimie Générale, OPU.
2. S.S. Zumdhal & coll., Chimie Générale, De Boeck Université.
3. Y. Jean, Structure électronique des molécules : 1 de l'atome aux molécules simples, 3ᵉ édition, Dunod, 2003.

4. F. Vassaux, La chimie en IUT et BTS.
5. A. Casalot & A. Durupthy, Chimie inorganique cours 2ème cycle, Hachette.
6. P. Arnaud, Cours de Chimie Physique, Ed. Dunod.
7. M. Guymont, Structure de la matière, Belin Coll., 2003.
8. G. Devore, Chimie générale : T1, étude des structures, Coll. Vuibert, 1980.
9. M. Karapetiantz, Constitution de la matière, Ed. Mir, 1980.

Semester: 1
Teaching unit : UEM 1.1.3
Matter 3: Computer Structure and Applications
VHS: 15h00 (Cours: 1h30, PW: 1h30)
Credits: 2
Coefficient: 2

Course Objectives

The aim of this course 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.

Course Content:

Part 1. Introduction to Computer Science   (5 Weeks)

1- Definition of Computer Science
2- Evolution of Computer Science and Computers
3- Information Encoding Systems
4- How a Computer Works
5- Computer Hardware
6- System Components
Basic Systems (Operating Systems (Windows, Linux, Mac OS, etc.))
Programming Languages, Application Software

Part 2. Concepts of Algorithms and Programs   (10 Weeks)

1- Concept of an Algorithm
2- Flowchart Representation
3- Program Structure
4- Problem-Taking and Analysis
5- Data Structure: Constants and Variables, Data Types
6- Operators: Assignment Operator, Relational Operators, Logical Operators, Arithmetic Operations, Order of Operations
7- Input/Output Operations
8- Control Structures: Conditional Control Structures, Repetitive Control Structures

Practical Exercises Computer Science 1:

The practical sessions (TPs) aim to illustrate the concepts taught during the lectures. These sessions must begin with the lectures according to the following schedule:
• Introductory practical sessions to familiarize students with the computer from a hardware and operating system perspective (exploration of the various functionalities of operating systems)
• Introductory practical sessions to using a programming environment (Editing, Assembly, Compilation, etc.)
• Practical sessions applying the programming techniques covered in the lectures.

Assessment Method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1- John Paul Mueller et Luca Massaron, Les algorithmes pour les Nuls grand format, 2017.

2- Charles E. Leiserson, Clifford Stein et Thomas H. Cormen, Algorithmique: cours avec 957 exercices et 158 problèmes, 2017.

3- Thomas H. Cormen, Algorithmes: Notions de base, 2013.

Semester: 1
Teaching unit : UED 1.1.1
Matter : Ethical and deontological dimension (the foundations)
VHS : 22h30 (Cours : 1h30)
Credits : 1
Coefficient : 1

Teaching Objectives:

The primary objective of this course is to facilitate an individual's immersion in student life and their transition into responsible adulthood. It helps develop students' awareness of ethical principles. It introduces them to the rules governing university life (their rights and obligations towards the university community) and in the workplace, raises awareness of respect for and the value of intellectual property, and explains the risks of moral evils such as corruption and how to combat them.

Recommended Prior Knowledge:

None

Subject Content:

I. Fundamental Concepts – Morality (2 weeks)
Definitions:
1. Morality:
2. Ethics:
3. Deontology "Theory of Duty":
4. Law:
5. Distinction between the different concepts
A. Distinction between ethics and morality
B. Distinction between ethics and deontology

II. References – Islam (2 weeks)

Philosophical References
Religious References
The Evolution of Civilizations
Institutional References

III. University Franchising – Al-Qaeda (3 weeks)

The Concept of University Franchises
Regulatory Texts
University Franchise Fees
University Campus Stakeholders
IV. University Values – Al-Qaeda (2 weeks)
Social Values
Community Values
Professional Values

V. Rights and Duties   (2 weeks)

Student Rights
Student Duties
Teacher Rights
Research Professor Obligations
Administrative and Technical Staff Obligations

VI. University Relations   (2 weeks)

Definition of the Concept of University Relations
Student-Teacher Relations
Student-Student Relations
Student-Staff Relations
Student-Member Relations

VII. Practices   (2 weeks)

Best Practices For the Instructor
Best Practices For the Student

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, G. A., Professionalism and Ethical Deliberation, Quebec, Presses de l'Université du Québec, 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 Age of Ethics. Education and Societies, 23.
7. https://elearning.univ-annaba.dz/pluginfile.php/39773/mod_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ontologie.pdf .

Semester: 1
Teaching unit: UED 1.1.1
Matter 1: Careers in science and technology
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:
The course aims, firstly, to introduce students to all the fields of study covered by the Science and Technology domain, and secondly, to present a range of careers that these fields lead to. In the same vein, this subject introduces the emerging challenges of sustainable development and the new professions that may arise from it.

Recommended Prior Knowledge:
None

Subject Content:
1. **What are engineering sciences?**

2. **Fields of study in Electronics, Telecommunications, Biomedical Engineering, Electrical Engineering, Electromechanics, Optics & Precision Mechanics:**

3. **Automation and Industrial Engineering Programs:**

4. **Process Engineering, Hydrocarbons and Petrochemical Industries:**

1. Industrial Health and Safety (IHS) and Mining Engineering Programs:

- Definitions and areas of application (Safety of property and people, Environmental issues, Exploration and exploitation of mineral resources, etc.)

- Role of the specialist in these fields.

2. Climate Engineering and Transportation Engineering Programs:
- Definitions and areas of application (Air conditioning, Smart buildings, Transportation safety, Traffic management and road, air, and maritime transport, etc.)

- Role of the specialist in these fields.

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

- Definitions and areas of application (Construction materials, Major road and rail infrastructure, Bridges, Airports, Dams, Drinking water supply and sanitation, Hydraulic flows, Water resource management, Public Works and land development, Smart cities, etc.)

- Role of the specialist in these fields.

4. Aeronautics, Mechanical Engineering, Maritime Engineering, and Metallurgy Programs:

- Definitions and areas of application (Aeronautics, Avionics, Automotive industry, Ports, Dikes, Industrial equipment production, Steel industry, Metal processing, etc.)

- Role of the specialist in these fields.

Assessment method:
Exam: 100%.

Group work: Develop job descriptions for professions within each sector based on recruitment advertisements found on job search websites (e.g., http://www.onisep.fr/Decouvrir-les-metiers, www.indeed.fr, www.pole-emploi.fr) (1 sector per group).
Depending on the institution's capacity, consider involving doctoral students and alumni in a tutoring/mentoring program where each group can work with its tutor/mentor to develop the job description/explore the various professions within the ST (Science and Technology) sector.

Individual student work for this subject: The instructor in charge of this subject can inform students that they can still be assessed by having them prepare job descriptions. Students are asked to watch a popular science film related to their chosen profession at home (after being provided with either the film on electronic media or an internet link) and then submit a written report or give an oral presentation summarizing the film, etc. The weighting of these activities is left to the discretion of the instructor and the training team, who are solely responsible for determining the best way to incorporate this individual work into the overall final exam grade.

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

Course Objectives

Students are led, step by step, toward an understanding of mathematics relevant to their university studies. By the end of the course, students should be able to: solve first- and second-degree differential equations; solve integrals of rational, exponential, trigonometric, and polynomial functions; and solve systems of linear equations using several methods.

Recommended Prior Knowledge

Basic concepts of mathematics (differential equations, integrals, systems of equations, etc.).

Course Content:

Chapter 1: Ordinary Differential Equations

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

Chapter 3: Double Integrals

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Bibliographical references:
[1] Kada Allab, Eléments d'Analyse. Office des publications Universitaires. Ben Aknoun. Alger 1984
[2] N. Piskounov, Calcul différentiel et integral. Editions Mir. Moscou 1978
[3] J. Dixmier, Cours de mathématiques du premier cycle. 1ère année. Gauthiers-Villars. Paris 1976
[4] R. Murray Spiegel. Théorie et applications de l'Analyse. McGraw-Hill, Paris 1973
[5] G. Flory, Topologie, Analyse. Exercices avec solutions. Vuibert. Paris 1978

Course Objectives

- Consolidate the knowledge acquired in the first semester.

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

- Transition between geometric and matrix representations.

Recommended Prior Knowledge
Algebra 1

Subject Content:

Chapter 1: Vector Spaces

Chapter 2: Linear Applications

Chapter 3: Matrices, associated matrices, and determinants

Chapter 4: Systems of Linear Equations

Chapter 5: Matrix Reduction.

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

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

- COLLET Valérie : MATHS Toute la deuxième année. ellipses

Teaching Objectives

- Identify the sources of electric and magnetic fields.

- Calculate and differentiate between vector and scalar fields.

- Calculate the electric field and potential produced by a charge distribution.

- Calculate the magnetic field produced by an electric current.

Recommended Prior Knowledge

- Concepts of vector fields and scalar fields.

- Concepts of vector calculus.

- Electric charges.

Course Content:

Chapter 1: Electrostatic Field and Potential

Chapter 2: The Drivers

Chapter 3: Electric Current

Chapter 4: Magnetostatics

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Bibliographical references:

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

Physique Générale, Electricité et magnétisme, Douglas Giancoli, éditions de Boeck

Semester: 2
Techning unit : UEF 1.2.4
Matter 1: Thermodynamics
VHS: 45h00 (TP: 1h30)
Credits: 2
Coefficient: 1

Objectifs de l'enseignement

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

Course Content:

Chapter I: Basic Concepts in Thermodynamics

Chapter II: Thermodynamic Properties of Pure Substances

Chapter III: Fundamental Concepts of Thermodynamics

Chapter IV: Equilibria of Physical Processes

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Bibliographical references:

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

Semester: 2
Teachnig unit: UEM 1.2.1
Matter 2: PW Electricity and magnetism
VHS: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Course Objectives

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

Recommended Prior Knowledge

Mathematics 1, Physics 1.

Course Content:

5 manipulations minimum (3 hours / 15 days)

- Presentation of measuring instruments and tools (voltmeter, ammeter, rheostat, oscilloscopes, generator, etc.).

- Kirchhoff's laws (loop law, node law).

- Thévenin's theorem.

- Association and measurement of inductances and capacitances
- Charging and discharging a capacitor
- Oscilloscope
- Practical work on magnetism

Assessment Method:
Continuous Assessment: 100%

Semester: 2
Teachnig unit: UEM 1.2.2
Matter 3: PW Thermodynamics
VHS: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Course Objectives

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

Recommended Prior Knowledge

None

Course Content:

Thermodynamics Practical Work:

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

PW No. 2: Water content of the calorimeter.

PW No. 3: Specific heat capacity: specific heat capacity of liquids and solids.

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

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

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

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

PW No. 8: Thermodynamic functions of an acid-base equilibrium.

PW No. 9: Study of the variation of pressure as a function of temperature at equilibrium (l-g) for a pure system: water. Lab 10: Vapor pressure of a solution.

PW 11: Equilibrium diagram for a binary system.

PW 12: Equilibrium diagram for a ternary system.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Course Objectives

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

Recommended Prior Knowledge

- No prior programming experience is required
- Basic math skills (high school level)
- Basic computer skills
- Basic knowledge of an operating system

Course Content:

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

Chapter 2: Structure of a C program and data types   **(2 weeks)**

Chapter 3: Inputs/Outputs and Expressions   **(2 Weeks)**

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

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

Chapter 6: Pointers and Dynamic Allocation   **(2 Weeks)**

Chapter 7: Structures and Enumerations   **(2 Weeks)**

Detailed content of the practical sessions
PW 1: Getting to grips with the environment

PW 2: Variables and expressions

PW 3: Conditional Structures and Iterative Structures

PW 4: Functions

PW 5: One-dimensional and multi-dimensional arrays

PW 6: Character Strings

PW 7: Pointers and Dynamic Allocation

PW 8: Files

Assessment Method:
Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

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

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

Subject Objective:

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

Subject Content:

Chapter 1: Foundations of Free Software   **(2 weeks)**

Chapter 2: Legal framework and licenses   **(2 weeks)**

Chapter 3: Free Operating Systems   **(3 weeks)**

Chapter 4: Free Office Solutions   **(3 weeks)**

Chapter 5: Creative Solutions and Development   **(3 weeks)**

Chapter 6: Prospects and future of free software   **(2 weeks)**

Workshops
Atl. 1: Introduction to Linux

Atl. 2: Software Management under Linux

Atl. 3: Migrating to LibreOffice

Atl. 4: Spreadsheets and free presentations

Section 5: Image Processing and Graphics

Atl. 6: Web and free databases

Atl. 7: Collaborative Development

Assessment method:
100% exam

Bibliographical references:

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

1. Documentation du projet GNU: https://www.gnu.org/doc/doc.html

2. Stallman, R. M. (2002). *Free Software, Free Society: Selected Essays of Richard M. Stallman.*GNU Press.

Teaching Objectives:

Of paramount importance for a scientist, this subject allows the student to acquire:
- The use of vector analysis for describing various physical and practical phenomena
- Mastery of the Fourier transform for the most common applications
- Mastery of the Laplace transform for solving differential equations and systems of differential equations

Subject Content:

Chapter 1: Vector Analysis

Chapter 2: Numerical and Integer Series

Chapter 3: Fourier Series

Chapter 4: Fourier and Laplace Transforms

Assessment Method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

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

Objective:
To 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

Contents:
Preamble: This subject is divided into two parts: Waves and Vibrations, which can be studied independently. Given the substantial nature of the subject matter, it is recommended that students in Electrical Engineering (Group A) begin with Waves, then Vibrations. Students in Groups B and C (Civil Engineering, Mechanical Engineering, and Process Engineering) should start with Vibrations. In any case, the instructor is expected to do their best to cover both parts. We remind you that this subject is intended for engineering careers in the Science and Technology field. Therefore, the instructor is asked to skim over any sections of the course that require demonstrations or theoretical explanations and focus solely on the applied aspects. Furthermore, the demonstrations can be assigned as supplementary work for students as part of their independent study. Refer to section "G - Student Assessment through Continuous Assessment and Independent Study" in this course outline for more details.

Part A: Vibrations
Chapter 1: Introduction to Lagrange's Equations (2 weeks)

Chapter 2: Free Oscillations of Systems with One Degree of Freedom   (2 weeks)

Chapter 3: Forced Oscillations of Systems with One Degree of Freedom   (1 week)

Chapter 4: Free Oscillations of Two-Degree-of-Freedom Systems   (1 week)

Chapter 5: Forced Oscillations of Two-Degree-of-Freedom Systems   (2 weeks)

Part B: Waves
Chapter 1: One-Dimensional Propagation Phenomena   (2 weeks)

Chapter 2: Vibrating Strings (2 weeks)

Chapter 3: Acoustic Waves in Fluids (1 week)

Chapter 4: Electromagnetic Waves (2 weeks)

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

Bibliographical references:

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

Semester: 3
Teaching unit: UEF 2.1.2
Matter 1: Fundamental Electronics 1
VHS: 45h00 (Cours: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Course 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
Concepts of materials physics and fundamental electricity.

Course Content:

Chapter 1. Continuous Regime and Fundamental Theorems   (3 weeks)

Chapter 2. Passive Two-Port Networks   (3 weeks)

Chapter 3. Diodes   3 weeks

Chapter 4. Bipolar Transistors   (3 weeks)

Chapter 5 - Operational Amplifiers: 3 weeks

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

Bibliographical references:
1. A. Malvino, Principe d'Electronique, 6ème Edition Dunod, 2002.
2. T. Floyd, Electronique Composants et Systèmes d'Application, 5ème Edition, Dunod, 2000.
3. F. Milsant, Cours d'électronique (et problèmes), Tomes 1 à 5, Eyrolles.
4. M. Kaufman, Electronique : Les composants, Tome 1, McGraw-Hill, 1982.
5. P. Horowitz, Traité de l'électronique Analogique et Numérique, Tomes 1 et 2, Publitronic-Elektor, 1996.
6. M. Ouhrouche, Circuits électriques, Presses internationale Polytechnique, 2009.
7. Neffati, Electricité générale, Dunod, 2004
8. D. Dixneuf, Principes des circuits électriques, Dunod, 2007
9. Y. Hamada, Circuits électroniques, OPU, 1993.
10. I. Jelinski, Toute l'Electronique en Exercices, Vuibert, 2000.

Course Objectives:

To know the basic principles of electrical engineering. To understand the operating principle of transformers and electrical machines.

Recommended Prior Knowledge

Basic concepts of electricity.

Course Content:

Preamble: This subject is divided into two parts, the Waves part and the Vibrations part, which can be approached independently of each other. In this regard and due to the consistency of this subject in terms of content, it is advisable to approach this subject in this order: Waves and then Vibrations for students in the Electrical Engineering (Group A) streams. 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 requested to skim over all parts of the course that require demonstrations or theoretical developments and to focus only on the applied aspects. Moreover, demonstrations can be the subject of an auxiliary work to be requested from students as activities within the framework of the student's personal work. For this purpose, consult paragraph "G- Student Assessment through Continuous Assessment and Personal Work" in this training offer.

Chapter 1. Mathematical Review of Complex Numbers (NC)   (1 Week)

Chapter 2. Review of the fundamental laws of electricity   (2 Weeks)

Chapter 3. Electrical Circuits and Power   (3 Weeks)

Chapter   4. Magnetic Circuits   (3 Weeks)

Chapter 5. Transformers   (3 Weeks)

Chapter 6. Introduction to Electrical Machines   (3 Weeks)

Assessment method:

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

Bibliographic References:

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

5. J. Edminister, Théorie et applications des circuits électriques, McGraw Hill, 1972

6. D. Hong, Circuits et mesures électriques, Dunod, 2009

7. M. Kostenko, Machines Electriques - Tome 1, Tome 2, Editions MIR, Moscou, 1979.

8. M. Jufer, Electromécanique, Presses polytechniques et universitaires romandes- Lausanne, 2004.

9. A. Fitzgerald, Electric Machinery, McGraw-Hill Higher Education, 2003.

10. J. Lesenne, Introduction à l'électrotechnique approfondie. Technique et Documentation, 1981.

11. P. Maye, Moteurs électriques industriels, Dunod, 2005.

12. S. Nassar, Circuits électriques, Maxi Schaum.

Course Objectives:

This module allows students to see the essential concepts 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

Course Content:

Part A: Statistics

Chapter 1: Basic Definitions (1 week)

Chapter 2: Single-Variable Statistical Series (3 weeks)

Chapter 3: Two-Variable Statistical Series (3 weeks)

Part B: Probability

Chapter 1: Combinatorial Analysis (1 Week)

Chapter 2: Introduction to Probability (2 weeks)

Chapter 3: Conditioning and Independence (1 week)

Chapter 4: Random Variables (1 Week)

Chapter 5: Common Discrete and Continuous Probability Laws (3 Weeks)

Assessment Method:

Continuous Assessment: 40%; Final Exam: 60%.

Bibliographic References:

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

6. A. Montfort. Cours de statistique mathématique. Economica, 1988.
7. A. Montfort. Introduction à la statistique. Ecole Polytechnique, 1991

Semester: 3
Teaching unit: UEM2.1.2
Matter 2: Python Programming
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 2
Coefficient: 2

Course Objectives:

- Acquire the practical foundations 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 math skills (high school level).

- Basic computer skills (file navigation, text editor).

Course Content:

Chapter 1. Installing and Using Python

Chapter 2. Basic Concepts

Chapter 3. Conditional Structures

Chapter 4. Loops

Chapter 5. Functions

Chapter 6: Lists and Tuples

Chapter 7: Dictionaries

Chapter 8: Objects and Classes

Chapter 9: The Files

Assessment method:

Continuous assessment: 40%; Final 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.. Apprendre à programmer avec Python 3. Editions Eyrolles, 2012;

[6] . Le Goff, V.. Apprenez à programmer en Python. Editions Eyrolles, 2019;

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

Practical work:

Practical Session 1: Getting started with the Python environment (1 week)

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

Practical Session 3: Conditional and Repetitive Structures (1 Week)

Practical Session 4: Functions and Modularity (1 Week)

Practical Session 5: Data Structures (1 Week)

Practical Session 6: File Manipulation and Final Project (1 Week)

Assessment method:

Continuous assessment: 100%.

Bibliographical references:

1. Cyrille, H. (2018). Apprendre à programmer avec Python 3. Eyrolles, 6ème édition. ISBN: 978-2212675214

2. Daniel, I. (2024). Apprendre à coder en Python, J'ai lu

3. Nicolas, B. (2024). Python, du grand débutant à la programmation objet Cours et exercices corrigés, 3eme édition, Ellipses

4. Ludivine, C. (2024). Selenium Maîtrisez vos tests fonctionnels avec Python, Eni

5. Lutz, M. (2013). Learning Python, 5ème edition O'Reilly. ISBN: 978-1449355739

Online Resources
- Documentation officielle Python : docs.python.org
- Exercices Python sur Codecademy : codecademy.com/learn/learn-python-3
- W3Schools Python Tutorial : w3schools.com/python/

Semester: 3
Teaching unit: UEM 2.1
Matter 1: PW of Electronics and Electrotechnics
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 2
Coefficient: 1

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

Recommended Prior Knowledge
Fundamental electronics. Fundamental electrical engineering.

Subject Content:
The practical work instructor is required to conduct a minimum of 3 Electronics practical sessions and 3 Electrical Engineering practical sessions from the list below:

Electronics Practical Session 1
PW 1: Fundamental Theorems
PW 2: Characteristics of Passive Filters
PW 3: Diode/Rectification Characteristics
PW 4: Stabilized Power Supply with Zener Diode
PW 5: Transistor Characteristics and Operating Point
PW 6: Operational Amplifiers

Electrical Engineering Practical Session 1
PW 1: Single-Phase Voltage and Current Measurement
PW 2: Three-Phase Voltage and Current Measurement
PW 3: Three-Phase Active and Reactive Power Measurement
PW 4: Magnetic Circuits (Hysteresis Loop)
PW 5: Transformer Tests
PW 6: Electrical Machines (Demonstration)

Assessment Method:
Continuous Assessment: 100%

Bibliographic references:

Semester: 3
Teaching unit: UEM2.1
Matter 2: PW Waves and Vibrations
VHS: 22h30 (PW: 1h30)
Credits: 1
Coefficient: 1

<u>**Subject Objectives:**</u>
The objectives assigned by this program focus on introducing students to the practical application of knowledge received on mechanical vibration phenomena restricted to low amplitude oscillations for one or two degrees of freedom, as well as the propagation of mechanical waves.

<u>**Recommended Prior Knowledge:**</u>
Vibrations and waves, Mathematics 2, Physics 1, Physics 2.

<u>**Subject Content:**</u>

Lab 1: Mass-Spring
Lab 2: Simple Pendulum
Lab 3: Torsion Pendulum
Lab 4: Oscillating Electrical Circuit in Free and Forced Regimes
Lab 5: Coupled Pendulums
Lab 6: Transverse Oscillations in Vibrating Strings
Lab 7: Hoffmann Groove Pulley
Lab 8: Electromechanical Systems (The Electrodynamic Loudspeaker)
Lab 9: Pohl Pendulum
Lab 10: Propagation of Longitudinal Waves in a Fluid

Note: It is recommended to choose at least 5 of the 10 proposed labs.

<u>**Assessment Method:**</u>
Continuous Assessment: 100%.

<u>**Bibliographic references:**</u>

Semester: 3
Teaching unit: UED 2.1
Matter 3: State of the art in electrical engineering
VHS: 22h30 (Cours: 1h30)
Crédits: 1
Coefficient: 1

Teaching Objectives:

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

Recommended Prior Knowledge

None

Subject Content:

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

2. Impact of Electrical Engineering on societal development: Advances in Microelectronics, Automation and Supervision, Robotics, Telecommunications development, Instrumentation in healthcare development, etc.

Assessment Method:

Exam: 100%

Bibliographic references:

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

Teaching Objectives:

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

Recommended Prior Knowledge

Concepts of energy and the environment.

Subject Content:

Chapter 1: Different Energy Resources

Chapter 2: Energy Storage

Chapter 3: Consumption, Reserves, and Evolution of Energy Resources

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

Semester: 4
Teaching unit: UEF 2.2.1
Matter 1: Electrotechnique fondamentale 2
VHS: 67h30 (Cours: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives:

Master the calculation of single-phase and three-phase power. Understand the different coupling methods. Determine the elements of equivalent models. Master the operation of different machines.

Recommended Prior Knowledge

Fundamental Electrotechnics 1

Subject Content :

Chapter 1: Review of Magnetostatics and Magnetic Circuits   (1 week)

Chapter 2: Transformer   (4 weeks)

Chapter 3: Direct Current Machines   (4 weeks)

Chapter 4: Synchronous Machines   (3 weeks)

Chapter 5: Asynchronous Machines   (3 weeks)

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

Bibliographic references:
1. Jacques LESENNE, Francis NOTELET et Guy SEGUIER, Introduction à l'électrotechnique approfondie, Technique et Documentation, 1981.
2. Pierre MAYE, Moteurs électriques industriels, Dunod, 2005.
3. R. Annequin et J. Boutigny, Cours de sciences physiques, électricité 3, Vuibert.
4. M. Kouznetsov, Fondement de l'électrotechnique.
5. H. Lumbroso, Problèmes résolus sur les circuits électriques, Dunod.
6. J.P Perez, R. Carles et R. Fleekinger, Electromagnétisme Fondements et Applications, 3e Edition, 1997.
7. A. Fouillé, Electrotechnique à l'Usage des Ingénieurs, Dunold, 1963
8. M. Kostenko L. Piotrovski, Machines Electriques - Tome 1, Tome 2, Editions MIR, Moscow, 1979.
9. MARCEL Jufer, Electromécanique, Presses Polytechniques et Universitaires Romandes-Lausanne, 2004.
10. A. E. Fitzgerald, Charles Kingsley Jr., Stephen D. Umans, Electric Machinery, McGraw-Hill Higher Education, 2003.
11. Edminster, Théorie et applications des circuits électriques, Mc.GrawHill.

Semester: 4
Teaching unit: UEF 2.2.1
Matter 2: Combinational and sequential logic
VHS: 45h00 (Cours: 1h30, TD: 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 maps. Introduce sequential circuits through flip-flops, counters, and registers.

Recommended Prior Knowledge

None.

Subject Content :

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

Chapter 2: Numbering Systems and Information Coding   (2 weeks)

Chapter 3: Combinational transcoder circuits   (2 weeks)

Chapter 4: Combinational switching circuits   (2 weeks)

Chapter 5: Combinational comparison circuits   2 weeks

Chapter 6: The 2-week switchovers

Chapter 7: The 2-Week Counters

Chapter 8. The Registers Week 1

Assessment Method:

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

Bibliographic references:

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

Semestre: 4
Teaching unit : UEF UEF 2.2.2
Matière 1: Production of electrical energy
VHS: 22h30 (Cours: 1h30)
Credits: 2
Coefficient: 1

Course Objectives

To understand, master, and acquire the basic principles of the different modes of electrical energy production. Upon completion of this course, the student should be aware of the energy challenge in general, and the impact of electrical energy on socio-economic life in particular.

Recommended Prior Knowledge

Fundamental Electrical Engineering 1

Course Content:

Chapter 1. Generalities (2 weeks)

History of electricity production. History of the evolution of electricity production in Algeria. Eco-design and sustainable development, renewable and non-renewable energies, economic aspects.

Chapter 2. Thermal power plants   (2 weeks)
Chapter 3. Generator sets   (2 weeks)
Chapter 4. Nuclear power plants   (2 weeks)
Chapter 5. Hydroelectric power plants   (2 weeks)
Chapter 6. Wind energy   (2 weeks)

Principles of aerodynamics and types of wind turbines, operating principle, grid interfacing, protection, and voltage regulation.

Chapter 7. Solar energy   (2 weeks)

Operating principle and technologies, characteristics, and optimum operating point.

Chapter 8. Fuel cells   (1 week)

Types of fuel cells and operating principle

Assessment Method:

Final Exam: 100%.

Bibliographic references:

1. Sabonnadière Jean Claude, Nouvelles technologies de l'énergie 1: Les énergies renouvelables, Ed. Hermès.
2. Gide Paul, Le grand livre de l'éolien, Ed. Moniteur.
3. A. Labouret,Énergie Solaire photovoltaïque, Ed. Dunod.
4. Viollet Pierre Louis, Histoire de l'énergie hydraulique, Ed. Press ENP Chaussée.
5. Peser Felix A, Installations solaires thermiques: conception et mise en œuvre, Ed. Moniteur,Dunod/L'Usine nouvelle, 2013.
6. B. Robyns et al, Production d'énergie électrique à partir des sources renouvelables (Coll. Sciences et technologies de l'énergie électrique), Lavoisier, 2012.
7. G. Laval, La fusion nucléaire : de la recherche fondamentale à la production d'énergie ?, EDP Sciences, 2007.

8. V. Crastan, Centrales électriques et production alternative d'électricité, Hermès-Lavoisier, 2009.

Course 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.

Course Content:

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

Chapter 2. Polynomial Interpolation   (2 Weeks)

Chapter 3. Function Approximation: (2 Weeks)

Chapter 4. Digital Integration   (2 Weeks)

Chapter 5. Solving Ordinary Differential Equations

(Initial Condition or Cauchy Problem)   (2 Weeks)

Chapter 6. Direct Method for Solving Systems of Linear Equations   (2 Weeks)

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

Assessment method:

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

PW Numerical Methods

Learning Objectives:

Programming of various numerical methods for their applications in mathematical calculations using a scientific programming language (Matlab, Scilab, etc.).

Recommended Prior Knowledge:

Numerical Methods, Computer Science 2 and 3.

Course Content:

Chapter 1: Solving Nonlinear Equations (3 weeks)

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

Chapter 2: Interpolation and Approximation   (3 weeks)

1. Newton interpolation, 2. Chebyshev approximation

Chapter 3: Numerical Integration   (3 weeks)

1. Rectangle method, 2. Trapezoidal rule, 3. Simpson's rule

Chapter 4: Differential Equations   (2 weeks)

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

Chapter 5: Systems of Linear Equations   (4 weeks)

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

Assessment method:

Continuous assessment: 100%

Bibliographical references:

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

Semester: 4
Teaching unit: UEF 2.2.2
Matière 2: Signal theory
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:
Acquire basic concepts of the mathematical tools used in signal processing.

Recommended prior knowledge:
Basic mathematics course.
Course Content:
Chapter 1. General Information on Signals   (3 Weeks)
Objectives of signal processing. Areas of application. Signal classification (morphological, spectral, etc.). Deterministic signals (periodic and non-periodic) and random signals (stationary and non-stationary). Causality. Concepts 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 Review (dot 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   (3 Weeks)
Signals 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. A.V. Oppenheim, "Signals and Systems," Prentice-Hall, 2004.
3. F. de Coulon, "Signal Theory and Processing," PPUR Edition.
4. F. Cottet, "Signal Processing and Data Acquisition, Courses 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 - Course 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, Traitement du signal

Semester: 4
Teaching unit: UEM 2.2
Matter 1: Electrical and electronic measurements
VHS: 37h30 (Course: 1h30, TP: 1h00)
Credits: 3
Coefficient: 2

Course Objectives:
To introduce students to electrical and electronic measurement techniques. To familiarize students with the use of analog and digital measuring instruments.

Recommended Prior Knowledge:
General Electricity, Fundamental Laws of Physics.

Course Content:
The number of weeks shown is for informational purposes only. The course instructor is not required to strictly adhere to this schedule or the chapter structure.

Chapter 1. Measurements, Quantities, and Uncertainties (5 weeks)

Introduction, Quantity, Standard, Unit Systems, Table of Multiples and Submultiples, Dimensional Equations, Useful Formulas, Measurement Accuracy, Measurement Error, Classification of Errors, Uncertainties in Indirect Measurements, Qualities of Measuring Instruments, Calibration of Measuring Instruments, Graphic Symbols of Measuring Instruments, General Measurement Methods (Deflection, Zero, and Resonance Methods), Application Exercises.

Chapter 2. Measurement Methods (6 weeks)

1. Voltage Measurements: Direct Voltage Measurement Methods, AC Voltage Measurements, Indirect Voltage Measurement Method Using the Opposition Method.
2. Current Measurements: Direct Current Measurement Method, Use of the Simple Shunt. 3. Resistance Measurements: Resistance Classification, Voltammetric Method, Zero Method: The Wheatstone Bridge, Measurement of Very High Resistances by the Pressure Drop Method.
4. Impedance Measurements: Capacitance Measurements, Inductance Measurements, AC Bridges.
5. DC Power Measurements: Fundamental Relationships, Ammeter and Voltmeter Method, DC Electrodynamic Wattmeter.
6. AC Power Measurements: Instantaneous and Average Power, Complex Power, Apparent Power, Active Power, and Reactive Power, AC Electrodynamic Wattmeter, 3-Voltmeter Method for Active Power, Direct Reactive Power Measurement Method, Indirect Reactive Power Measurement Method.
7. Phase Shift Measurements: Direct Phase Shift Measurement with an Oscilloscope, Phase Shift Measurement with Lissajous Patterns. 8. Frequency and Period Measurements: Direct Frequency Measurement with an Oscilloscope, Frequency Measurement with Lissajous Patterns, Frequency Measurement Using the Frequency Meter Method, Frequency Measurement Using the Period Meter Method, and Application Exercises.

Chapter 3. Measuring Devices (4 weeks)

Introduction

Analog Measuring Devices: Classification of Deflection Devices, Moving Coil Galvanometer, Structure of the Magnetoelectric Ammeter, Structure of the Magnetoelectric Voltmeter, Operation of the Electrodynamic Wattmeter in AC Power

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 Lab:

Laboratory Lab 1: Resistance Measurement:
Measure resistance using the following five methods: voltammetric, ohmmeter, Wheatstone bridge, comparison and substitution.
Compare these methods and calculate the error.

Laboratory Lab 2: Inductance Measurement:
Measure inductance using the following three methods: voltammetric, Maxwell bridge, resonance.
Compare these methods and calculate the error.

Laboratory Lab 3: Capacitance Measurement:
Measure capacitance using the following three methods: voltammetric, Sauty bridge, resonance.
Compare these methods and calculate the error**.**

Laboratory Lab 4: Phase Shift Measurement:
Measure resistance using the following two methods: phase meter and oscilloscope.

Lab 5: Single-Phase Power Measurement:
Measure resistance using the following five methods: wattmeter, cosφmeter, three voltmeters, three ammeters, and a power sensor.
Compare these methods and calculate the errors.

Lab 6: Three-Phase Power Measurement:
Measure resistance using the following methods: star and delta systems, balanced and unbalanced.

Assessment Method:
Continuous Assessment: 40%; Final Exam: 60%.

Bibliographic references:
1- M. Cerr, Industrial Instrumentation: Vol. 1, Tec and Doc. Edition
2- M. Cerr, Industrial Instrumentation: Vol. 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, 2010.
8- L. Thompson, Electrical Measurements and Calibration: Fundamentals and Applications, Instrument Society of America, 1994.
9- J. P. Bentley, Principles of Measurement Systems, Pearson Education, 2005.
10- J. Niard, 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, 14- A. Leconte, Measurements in electrotechnics (Document D 1 501), The techniques of the engineer.

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
Matter 2: TP Fundamental electrotechnical 2
VHS: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Course Objectives

Consolidate the knowledge acquired in the fundamental electronics and electrical engineering disciplines through practical work to better understand and assimilate the fundamental laws of electrical engineering and the operation of transformers and motors.

Recommended Prior Knowledge

Fundamental Electrical Engineering 2.

Subject Content:

Laboratory No. 1: No-load, On-load, and Short-circuit Tests of a Single-phase Transformer

Laboratory No. 2: On-load Test of a Three-phase Transformer

Laboratory No. 3: Characteristics of a Direct Current Generator
Shunt and Separate Excitation, Self-Starting

Lab No. 4 Characteristics of a DC Motor
Shunt and Series Excitation, Starting Rheostat

Lab No. 5 Load Characteristics of an Asynchronous Motor

Lab No. 6 Determining the Circular Diagram of an Asynchronous Machine

Lab No. 7 Alternator - Functional Diagram –

Assessment Method:

Continuous Testing: 100%.

Bibliographic References:

(Books and handouts, websites, etc.)

Semester: 4
Teaching unit : UEM 2.2
Matter 3: PW Combinatorial and sequential logic
VHS: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:
Consolidate the knowledge acquired during the "Combinational and Sequential Logic" course through practical exercises to better understand and assimilate the content of this subject.

Recommended Prior Knowledge:
Combinational and Sequential Logic.

Subject Content:

The teacher selects between 4 and 6 practical exercises from this list, covering both types of logic circuits (combinational and sequential).

PW 1: TTL and CMOS Integrated Circuit Technology. Understand and test different logic gates

PW 2: Simplifying logic equations through practice
Discover the rules for simplifying equations in Boolean algebra through practice

PW 3: Study and implementation of common combinational logic functions
Examples: switching circuits (MUX, DMUX), coding and decoding circuits, etc.

PW 4: Study and implementation of an arithmetic combinational circuit
Implementation of an adder and/or subtractor circuit for two 4-bit binary numbers.

PW 5: Study and implementation of a combinational logic circuit
Implementation of a logic function using logic gates. 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.

PW 6: Study and implementation of a combinational logic circuit
Complete study (truth table, simplification, logic diagram, practical assembly, and testing) of a combinational circuit based on a specification.

PW 7: Study and implementation of counter circuits
Incomplete asynchronous counter circuits using flip-flops, synchronous counter circuits with irregular cycles using flip-flops

PW 8: Study and implementation of registers

Assessment Method:
Continuous Testing: 100%.

Bibliographic References:
1. J. Letocha, Introduction aux circuits logiques, Edition Mc-Graw Hill.

2. J.C. Lafont, Cours et problèmes d'électronique numérique, 124 exercices avec solutions, Edition Ellipses.

Semester: 4
Teaching unit : UET 2.2
Matter 4: TIC
VHS: 45h00 (Cours: 1h30 & Workshop : 1h30)
Credits: 2
Coefficient: 2

Course Objectives

This course aims to develop in students the transversal skills necessary for communicating scientific knowledge. It focuses on mastering literature searches and the use of digital tools (ICT) to collect and organize information, writing clear and well-structured scientific documents (introduction, methodology, results, discussion according to the IMRaD model), delivering compelling oral presentations tailored to the audience, and adhering to ethical and integrity guidelines (particularly intellectual integrity when citing sources). The course emphasizes clarity and conciseness in scientific style – writing must be "precise, clear, and concise" – as well as the ethics of communication (avoiding plagiarism, properly citing sources, etc.).

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

Course Content:

Chapter 1: Introduction to Scientific Communication   (1 week)
Chapter 2: Documentary Research and ICT   (1 week)
Chapter 3: Referencing and Bibliography   (1 week)
Chapter 4: Structure of a Scientific Document   (1 week)
Chapter 5: Writing the Scientific Paper   (3 weeks)
Writing the Introduction and Abstract:
How to write an effective introduction: presenting the context, formulating the research question and objectives. Writing an informative abstract: structure (context, objective, methods, results, conclusion) and keywords. Techniques to engage the reader from the start.
Writing 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). Distinguishing between facts (results) and interpretation (discussion). Clarity rules: simple sentences, active voice/precise verbs.
Discussion, Conclusion, and Style:
Writing the discussion (putting the results into perspective, comparing them to other work) and formulating a concise conclusion. Style rules in scientific writing: clarity, conciseness and precision of language, managing coherence and cohesion (logical connectors). Common Mistakes to Avoid

Chapter 6: Introduction to Oral Presentations and Public Speaking Techniques (2 weeks)
Public Speaking Techniques:
Body language and vocal techniques to capture attention: posture, gestures, eye contact, variations in tone and rhythm. Managing stress and stage fright. Best practices: avoid reading notes verbatim; only use keywords to prevent boring the audience. Use of visual aids (paper, slides).

Chapter 7: Visual Aids and ICT for Presentations   (1 week)
Chapter 8: Professional Written Expression   (1 week)
Chapter 9: Interpersonal Communication and Listening   (1 week)

Chapter 10: Ethics and Academic Integrity   (1 week)
Chapter 11: Scientific Standards and Practices   (1 week)
Workshops:
Workshop 1: Note-taking exercise based on a short video or scientific text; sharing of effective note-taking techniques (active listening, keywords, organization).

Workshop 2: Bibliographic research workshop: finding 5 relevant references on a given topic, downloading them or extracting their abstracts; critical evaluation of the reliability of the sources (reviewer, date, content).

Workshop 3: Citation exercise: identifying and formatting references in a given text. Creating a bibliography according to a given style.

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

Workshop 5:
• Writing a 150-200 word abstract from a provided scientific article or short presentation. 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 with a deliberately confusing scientific paragraph, rework the wording to make it clearer and more concise. Correct long or convoluted sentences.

ATL: 6
• Presentation preparation exercise: Each student prepares a short oral outline on a simple topic in a few minutes, then presents it briefly. Feedback on argumentation and structure.

• Short individual oral presentations on a familiar topic, with optional video recording. 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 professor or supervisor (request for information, project submission). Collaborative proofreading of a text to eliminate common errors.

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

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

Assessment Method:
Continuous Testing: 100%.

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

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

Semester: 5
Teaching unit : UEF 3.1.1
Matter 1: Electrical Networks
VHS: 67h30 (Course: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Course Objectives:
To provide an overview of the management and sizing of the electrical power network (transmission and distribution).

Recommended Prior Knowledge:
Basic electrical engineering courses (electricity and circuits, electric and magnetic fields, power, three-phase system, alternator, motor, transformer).

Subject Content:
Chapter I: General Information on Electrical Networks (1 week)
- Organization of the Electrical Network
- Power Plants
- Electrical Substations (power transformers, instrument transformers (current and voltage), circuit breakers, disconnectors, other substation equipment, etc.)
- Other network elements (supports, conductor cables, overhead lines, underground lines, earth wires, busbars, insulators); Dispatching Center.

Chapter II: Modes of Transmission, Distribution, and Electricity (2 weeks)
- Description of Electrical Networks (structure of electrical networks, voltage levels); - Topology of electrical networks (HV/MV substations, MV networks, HVA/LV substations, LV networks).

Chapter III: Modeling Power Lines (5 weeks)
- Longitudinal characteristics (resistance, longitudinal reactance, concept of geometric mean radius and geometric mean distance);
- Transverse characteristics (transverse reactance, conductance due to corona effect);
- Calculation of electrical networks (general operating equations, equivalent circuits, voltage drop calculation, FERRANTI effect);
- Power transmission and power factor compensation in lines.

Chapter IV: Transformers and the relative unit system (2 weeks)
- Review (single-phase and three-phase transformers, modeling and determination of transformer parameters, transformer coupling (different modes, choice of coupling));
- Parallel connection of three-phase transformers (benefits, conditions, hourly time index);
- Main types of transformers (current measurement, voltage measurement, on-load tap changer, phase shifter, three-winding transformer, and autotransformer);
- Relative unit system (basic quantities (power, voltage, impedance), choice of base, base change).

Chapter V: Calculating Short-Circuit Currents (5 weeks)
- Calculating short-circuit currents (causes, consequences, different types, concept of symmetrical and asymmetrical short circuits, etc.);
- Calculating short-circuit currents using symmetrical components (symmetrical component method, construction of sequential networks, etc.);
- Equivalent impedances of network elements.

Références:

[1] **Debaprya.DAS**, « Electrical power system », Indian institute of technology, New Delhi, **2006.**

[2] **John J. Grainger, WUliam D. Stevenson, Jr.** « Power system analysis », .North carolina state Uniccrsity,**1994.**

[3] **J. Duncan Glover, Mulukutla S. Sarma, and Thomas J. Overbye,** «Power System Analysis and Design, Fifth Edition, SI», failure electrical, llc, USA, **2008**

[4] J. Lewis Blackburn, « Symmetrical Components for Power Systems », Department of Electrical Engineering, Ohio State University Columbus, Ohio, 1993.

[5] Jean-Pierre Muratet, « éléments économiques et de planification pour les réseaux de transport et distribution d'électricité », ALSTOM, 1998.

[6] Serge Pichot , « Lignes de transport HT» *FCI SAAE Transmission,* 1998.

[7] Daniel . Noel, « Postes MT/BT», ALSTOM, 1998.

[8] Guide de conception des réseaux électriques industriels T & D, « Architecture des réseaux électriques» ; Schneider electric, 6 883 427/A.

[9] Guide de conception des réseaux électriques BT, « Transformateur, définitions et paramètres caractéristiques» ; Schneider electric, B92.

[10] «La GRTE organisation et missions», 10ème Conférence Nationale sur la haute Tension CNHT16, mai 2016.

[11] Avril Charles, « Construction des lignes aériennes à haute tension », Paris : Editions Eyrolles , 1974

[12] Souad Chebbi, « Défauts dans les réseaux électriques »,support pédagogique, Université Virtuelle de Tunis.

[13] Electrotechnique deuxième édition, Presses internationales polytechniques, 1999.

[14] J. C. Gianduzzo : Cours et travaux dirigés d'électrotechnique, polycopiés de cours et de TD de Licence EEA de l'Université de Bordeaux 1.

[15] L. Lasne : L'électrotechnique pour la distribution d'énergie, Polycopié de cours de l'Université de Bordeaux 1, 2004.

[16] T. Wildi : Électrotechnique Troisième édition, Les presses de l'université de Laval, 2000.

[17] N. HADJSAID, J.C. SABONNADIERE, 'Lignes et Réseaux Electriques 1 : Lignes d'énergie électrique', édition : HERMES - LAVOISIER, 2007 ;

Course Objectives:
Understand the basic principles of power electronics, Understand the operating principle and use of power components, Master the operation of the main static converters, Acquire the basic knowledge for making technical choices based on the field of application of a power converter.

Recommended Prior Knowledge:
Fundamental Electronics 1, Fundamental Electrical Engineering 1.

Course Content :

The number of weeks shown is for informational purposes only. The course instructor is not required to strictly adhere to this schedule or the chapter layout.

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 (by switching mode, by conversion mode). Non-sinusoidal periodic quantities (rms values, average values, form factor, ripple rate).

Chapter 2. AC-DC Converters (3 weeks)
Power components (diodes and thyristors), Single-phase rectification, load types R, RL, RLE. Three-phase rectifiers, load types R, RL, RLE. Analysis of the commutation (encroachment) phenomenon in uncontrolled and controlled static rectifier converters.

Chapter 3. AC-DC Converters (3 weeks)
Power components (triacs with a quick review of diodes and thyristors), Single-phase dimmer, with load R, RL. Single-Phase Cycloconverter Principle

Chapter 4. DC-DC Converters (3 weeks)
Power Components (GTO thyristor, bipolar transistor, MOSFET transistor, IGBT transistor), Buck and Boost Chopper, with R, RL, and RLE loads.

Chapter 5. DC-AC Converters (3 weeks)
Single-Phase Inverter, Half-Bridge and Bridge Circuits with R and RL loads.

Assessment Method:
Continuous Assessment: 40%; Final Exam: 60%.

Bibliographic References:
1. L. Lasne, "Power Electronics: Courses, Case Studies, and Corrected Exercises," Dunod, 2011.
2. P. Agati et al. "Quick Reference: Electricity-Control and Power Electronics-Electro-Technology", Dunod, 2006.

3. J. Laroche, "Power Electronics - Converters: Courses and Corrected Exercises", Dunod, 2005.
4. G. Séguier et al. "Power Electronics: Courses and Corrected Exercises", 8th edition; Dunod, 2004.
5. D. Jacob, "Power Electronics - Principle of Operation, 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. C.W. Lander, "Power Electronics", McGraw-Hill, 1981
9. H. Buhler, "Control and Regulation Electronics; A Treatise on Electricity". 10. F. Mazda, "Power Electronics Handbook: Components, Circuits and Application," 3rd Edition, Newness, 1997.
11. R. Chauprade, "AC Motor Controls (Power Electronics)," 1987.
12. R. Chauprade, "DC Motor Controls (Power Electronics)," 1984.

Course Objectives:
Review the properties of control structures for continuous linear systems, introduce models of basic dynamic systems, and explore tools for time and frequency analysis of basic systems.

Recommended Prior Knowledge:
Basic mathematics (algebra, integral and differential calculus, analysis, complex systems, etc.). Fundamentals of signal processing and basic electronics (linear circuits).

Course Content:
Chapter 1. Introduction to Control Systems (2 Weeks)
History of automatic control systems, Terminology and definitions, System concepts, Dynamic behavior, Static behavior, Static systems, Dynamic systems, Linear systems, Introductory examples, Open-loop systems, Closed-loop systems, Main elements of a control chain, Rationale for a control system, Performance of control systems.

Chapter 2. System Modeling (4 Weeks)
Representing Systems by Their Differential Equations, Laplace Transform, From Differential Equation to Transfer Function, Functional Blocks and Subsystems, Simplification Rules, System State Representation, Correspondence Between State Representation and Transfer Function, Calculation of Transfer Functions for Looped Systems.

Chapter 3. Time Responses of Linear Systems (3 Weeks)
Definition of System Response, Transient Regime, Steady State, Notions of Stability, Speed, and Static Accuracy, Impulse Response (1st and 2nd Order), Time Characteristics, Step Response (1st and 2nd Order), Identification of First- and Second-Order Systems from the Time Response, Higher-Order Systems, Influence of Poles and Zeros on System Response.

Chapter 4. Frequency Responses of Linear Systems (3 Weeks)
Definition, Bode and Nyquist Diagrams, Frequency Characteristics of Basic Dynamic Systems (1st and 2nd Order), Phase and Gain Margins.

Chapter 5. Stability and precision of servo systems (3 Weeks)
Definition, Stability Conditions, Algebraic Routh-Herwitz Criterion, Reversal Criteria in the Nyquist and Bode Planes, Stability Margins, Accuracy of Controlled Systems, Static Accuracy, Calculation of Static Deviation, Dynamic Accuracy, Characterization of Transient Regimes.

Assessment Method:
Continuous Assessment: 40%; Exam: 60%.

Bibliographic references:
1. E. K. Boukas, Controlled Systems, Editions de l'École polytechnique de Montréal, 1995.
2. P. Clerc, Continuous and Sampled Control Systems: IUT Electrical Engineering-Industrial Computing, BTS Electronics-Mechanics-Computer Science, Editions Masson (198p), 1997.
3. Ph. de Larminat, Control Systems, Editions Hermes 2000.
4. P. Codron and S. Leballois, Control Systems: Continuous Linear Systems, Editions Dunod 1998.

5. Y. Granjon, Control Systems: Linear, Nonlinear, Continuous-Time, Discrete-Time Systems, State Representation, Editions Dunod 2001.
6. K. Ogata, Modern Control Engineering, Fourth Edition, Prentice Hall International Editions 2001.
7. B. Pradin, Course in Control Systems. INSA Toulouse, 3rd year, GII specialty.
8. M. Rivoire and J.-L. Ferrier, Automatic Control Course, Volume 2: Servo-Control, Regulation, Analog Control, Editions Eyrolles 1996.
9. Y. Thomas, Linear Signals and Systems: Corrected Exercises, Editions Masson 1993.
10. Y. Thomas. Linear Signals and Systems, Editions Masson 1994.

Semester: 5
Teaching unit : UEF 3.1.2
Matter 2: Electromagnetic Field Theory
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:

To deepen and consolidate concepts of electromagnetism. To grasp the physical and mathematical tools needed to understand Maxwell's equations and wave propagation.

Recommended Prior Knowledge:

Vector calculus, concepts of gradient, divergence, and rotation – Concepts of electrostatics and magnetostatics.

Course Content:

Chapter 0: Vector Concepts: (1 Week)

Physical definition of gradient, divergence, and rotation, vector and pseudovector, vector operators, Stocks' and Ostrogradski's theorem, concept of solid angle. Chapter 1: Electrostatics: (3 Weeks)

Maxwell's Equations in Electrostatics, Relationship of Dielectric Media, Distribution of Electric Charges, Force, Symmetry Considerations, Gauss's Theorem, Electric Flux, Electric Scalar Potential, Flow and Boundary Conditions, Poisson's and Laplace's Equations in Electrostatics, Coulomb's Law, Electrostatic Energy, Capacitance, Electrostatic Dipole.

Chapter 2. Magnetostatics: (3 Weeks)

Maxwell's Equations in Magnetostatics, Relationship of Magnetic Media, Distribution of Electric Currents, Considerations of Symmetries, Ampere's Theorem, Magnetic Flux, Magnetic Vector Potential, Transition and Boundary Conditions, Poisson's and Laplace's Equations in Magnetostatics, Biot and Savard's Law, Laplace's Force, Hall Effect, Legal Definition of Ampere, Magnetostatic Energy, Inductance and Reluctance, Magnetic Dipole.

Chapter 3. Variable Regime: (3 Weeks)

Maxwell's Equations in Any Variable Regime, Maxwell-Faraday Law (Faraday's Law and Lenz's Law) and Lorentz Gauge, Electric and Magnetic Field Propagation Equation, Electric Scalar Potential and Magnetic Vector Propagation Equation, Transition and Boundary Conditions, Solving Propagation Equations (Delayed Potentials), Electromagnetic Energy and Poynting Vector.

Chapter 4. Slowly Variable Regime – Electromagnetic Induction: (3 Weeks)

Approximation of Quasi-Stationary Regimes "ARQS", Conduction and Displacement Current, and Maxwell-Ampère Equation, Conservation and Relaxation of Electric Charge in Conductors, Local Ohm's Law, Magnetodynamic Equation, Coupled Electrical Circuits, Neumann Induction, Lorentz Induction, Laplace Action, Magnetic Energy and Coenergy.

Chapter 5. Rapidly Variable Regime – Wave Propagation: (2 Weeks)

Propagation equation of any wave, Plane wave and its characteristics, Propagation in any direction (speed and wavelength), Transmission and reflection of waves, Guided waves, Spectrum of electromagnetic radiation, Propagation of electromagnetic energy.

<u>Assessment method:</u>

Continuous assessment 40%; Exam: 60%.

Bibliographic references:
1. Rosnel, "Elements of Electromagnetic Propagation, Fundamental Physics", McGraw-Hill, 2002.
2. Garing, "Electromagnetic Waves in Dielectric Media: Exercises and Corrected Problems", 1998.
3. Paul Lorrain, Dale Corson, and François Lorrain, "Electromagnetic Phenomena: Lectures, Exercises, and Solved Problems", 2002.
4. Louis de Broglie, "Electromagnetic Waves and Photons", 1968.
5. Garing, "Electromagnetic Waves in Vacuum and Conducting Media: Exercises and Corrected Problems", 1998.
6. Michel Hulin, "Nicole Hulin and Denise Perrin, Maxwell's Equations: Electromagnetic Waves. Lectures, Exercises, and Solved Problems", 1998.

Semester: 5
Teaching unit: UEM 3.1
Matter 1: Diagrams and Electrical Equipment
VHS: 37h30 (Course: 1h30, TP: 1h00)
Credits: 3
Coefficient: 2

Course Objectives:
Learn the different types of protection and control devices for electrical installations, as well as how to build an electrical installation.

Recommended Prior Knowledge:
Basic concepts of electricity, electrostatics, and magnetostatics.

Course Content:
Chapter I: Electrical Equipment
• Switches (definition, role, and characteristics)
• Switches (definition, role, and characteristics)
• Disconnectors (definition, role, and characteristics)
• Contactors (definition, role, and characteristics)
• Fuses (role and operation, types, equations)
• Thermal Relays (definition, role, type, and characteristics)
• Electromagnetic Relays (definition, role, type, and characteristics)
• Circuit Breakers (definition, role, types, and characteristics)
• Active and Passive Sensors: Symbols, Roles, and Uses

Chapter II: Developing Electrical Diagrams
• Standardized Symbols for Electrical Equipment
• Classification of Diagrams According to the Method of Representation
• Conventions and Standardization
• Rules and Standards for Creating an Electrical Diagram

Chapter III. Lighting Circuits
III.1. Single-Switch Circuit
III.2. Dual-Switch Circuit
III.3. Two-Way Circuit
III.4. Impulse Switch Ignition
III.5. Timer Ignition
III.5.1. Principle of a 4-Wire Timer
III.5.2. Principle of a 3-Wire Timer

Chapter IV. Three Modes of Controlling an Electric Motor
IV.1. Direct-on-Line Starting with a Single Direction of Rotation
IV.2. Direct-on-Line Motor Starting with a Dual Direction of Rotation
IV.3. Star-Delta Starting

Practical Activities

Laboratory Work 1: Main lighting assemblies:

Installation of an electrical outlet, single-circuit assemblies, dual-circuit assemblies, two-way assemblies, remote control assemblies, timer assemblies

Laboratory Work 2: Manual control of a contactor and two contactors:

By switch, by pushbutton, remotely by two momentary pushbuttons, remotely by several pushbuttons.

Laboratory Work 3: Starting a three-phase squirrel-cage induction motor in one direction

Laboratory Work 4: Starting a two-way induction motor

Laboratory Work 5: Star-delta starting of an induction motor

Assessment Method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. Schneider technical specifications.
2. Le grand technical specifications.
3 http://www.yesss-fr.com/tech/symboles-electriques.php
4 http://www.repereelec.fr/dm2sm.htm
5. "Electrical Diagram Guide," Thierry Gallauziaux, David Fedullo
Published by Eyrolles, collection: Les cahiers du bricolage; 2009 (2nd edition)
6. "The Electrical Schematic", Hubert Largeaud, Edition Eyrolles – 1991 (-3rd Edition)
7. Christophe Prévé-, "Protection of Electrical Networks", Hermès, Paris, 1998.
8. S. H. Horowitz, A.G. Phadke, "Power System Relaying", second edition, John Wiley & Sons, 1995.
9. L. Féchant, "LV Electrical Switchgear, Distribution Devices", Engineering Techniques, Electrical Engineering treatise, D 4 865.

Semester: 5
Teaching unit: UEM 3.1
Matter 2: TP Electrical Networks
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

Learning Objectives:
To observe and understand the behavior of a power line, including voltage drop, voltage regulation, and reactive energy compensation. To establish power flow and calculate voltage drop, and to understand energy transfer between two stations.

Recommended Prior Knowledge:
Basic electrical engineering.

Subject Content:

Laboratory Work 1: Study of line efficiency and power factor improvement.

Laboratory Work 2: Voltage regulation using the reactive energy compensation method using capacitors.

Laboratory Work 3: Direct Current Model: Power Distribution and Voltage Drop Calculation.

Laboratory Work 4: Parallel Operation of Transformers.

Assessment Method:
Continuous Assessment: 100%.

References:
1. Sabonnadière, Jean-Claude, "Lignes et réseaux électriques", Vol. 1, Electric Power Lines, 2007.
2. Jean-Claude Sabonnadière, "Electrical Power Lines and Networks," Vol. 2, Electrical Network Analysis Methods, 2007.
3. Luc Lasne, "Electrical Engineering Exercises and Problems: Basic Concepts, Electrical Networks and Machines," 2011.
4. J. Grainger, "Power System Analysis," McGraw Hill, 2003
5. W.D. Stevenson, "Elements of Power System Analysis," McGraw Hill, 1982.

Course Objectives:
Complete, consolidate, and verify the knowledge already acquired in the course.

Recommended Prior Knowledge:
Basic electrical and electronic circuits.

Course Content:

Laboratory 1: Switching Components (IGBT, MOS).

Laboratory 2: Single-Phase and Three-Phase Uncontrolled Rectifier (R, L Load).

Laboratory 3: Single-Phase and Three-Phase Controlled Rectifier (R, L Load).

Laboratory 4: Chopper.

Laboratory 5: Single-Phase Inverter.

Laboratory 6: Single-Phase Dimmer (R, L Load).

Laboratory 7: Three-Phase Dimmer.

Assessment Method:
Continuous Assessment: 100%.

References:

Semester: 5
Teaching unit: UEM 3.1
Matière 4: TP Servo Systems / TP Sensors
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

Course Objectives:
Complete, consolidate, and verify the knowledge already acquired in the Control Systems and Sensors and Metrology courses.

Recommended Prior Knowledge:
Control Systems.

Course Content:

Laboratory 1: Study of the Behavior of 1st, 2nd, and 3rd Order Systems
Analog and Computer Simulation. Measure the parameters that characterize the different responses: rise time; response time; first maximum overshoot, peak time, and accuracy. Observe the response of an unstable system.

Laboratory 2: Frequency Responses and System Identification
Determination of the frequency characteristics of a control system, with the aim of identifying a system's transfer function. Application to a motor.

Lab 3: Position control of a DC motor, difference between position and speed
The influence of gain on the stability and static error of the system, The influence of speed feedback on system behavior.

Lab 4: Speed control of a DC motor
The operation of the components and the controlled system in open and closed loops, The influence of gain on system stability, The influence of gain and load on the static error of the system, The influence of current feedback on the dynamic behavior of the system.

Lab 5: Stability and accuracy of controlled systems
Analog and computer simulation. Study the stability and accuracy of controlled systems by modifying their parameters (resistance, capacitance, inductance, etc.) and their architectures (series, parallel). Application of the Routh-Hurwitz algebraic criterion, and criteria in the Nyquist and Bode planes. Measure the stability margin, calculate static and dynamic errors, and calculate accuracy for different types of systems (presence of integrators, differentiators, etc.) and for different input types (step, ramp, pulse).

Sensors:
Photometric sensors, Mechanical quantity sensors: deformation, force, position, rotational speed, Temperature sensors.

Assessment method:
Continuous monitoring: 100%.

Bibliographic references :

Course Objectives:
Understand the different components of a measurement chain: The operating principle of a sensor, metrological characteristics, the appropriate conditioner, and basic knowledge of the data acquisition chain.

Recommended Prior Knowledge:
Electrical and Electronic Measurements, Basic Electronics.

Course Content:

Chapter 1. General Information (2 Weeks)
The components of a measurement chain, sensors (passive, active), conditioning circuits (divider, bridges, amplifiers, and instrumentation amplifiers). Classification of Sensors

Chapter 2. Temperature Sensors (2 Weeks)
Platinum probe, thermistor, thermocouple, semiconductor thermometer, optical pyrometer

Chapter 3. Photometric Sensors (2 Weeks)
Photometric quantities, photoresistor, photodiode, phototransistor.

Chapter 4. Position Sensors (2 Weeks)
Resistive, Inductive, Capacitive, Digital, Proximity

Chapter 5. Strain, Force, and Pressure Sensors (2 Weeks)

Chapter 6. Rotational Speed Sensors (2 Weeks)
Analog and Digital Tachometers

Chapter 7. Flow, Level, and Humidity Sensors (2 Weeks)

Chapter 8. Data Acquisition Chain (1 Week)

Assessment Method:
Exam: 100%

Bibliographic References:
1. Georges Asch and Collaborators, "Sensors in Industrial Instrumentation", Dunod, 1998.
2. Ian R. Sintclair, "Sensors and Transducers", NEWNES, 2001.
3. J. G. Webster, "Measurement, Instrumentation, and Sensors Handbook", Taylor & Francis Ltd.
4. M. Grout, "Industrial Instrumentation: Specification and Installation of Sensors and Control Valves", Dunod, 2002.
5. R. Palas-Areny, J. G. Webster, "Sensors and Signal Conditioning", Wiley and Sons, 1991.
6. R. Sinclair, "Sensors and Transducers", Newness, Oxford, 2001.

Semester: 5
Teachin unit: UED 3.1
Matter 2: Electrical systems design
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:
To be able to calculate and size an electrical machine according to the requirements of specific specifications.

Recommended Prior Knowledge:
Components and operating principles of electrical machines.

Course Content:
Chapter 1 – Review (1 week)
Review of materials for electrical machines: Insulators; Conductors; Magnetics

Chapter 2. Transformers (3 weeks)
Review of the operating principle and their uses
Sizing a single-phase transformer, Selection of the active material (magnetic circuit, conductive and insulating materials, mechanical components).

Chapter 3. Direct Current Electrical Machines (3 weeks)
Review of the operating principle and their uses
Sizing the machine, Selection of the winding, nameplates.

Chapter 4. Asynchronous Machines (3 Weeks)
Review of the operating principle and their uses
Dimensioning of an asynchronous machine, Selection of the winding, Selection of asynchronous motors.

Chapter 5. Synchronous Machines (3 Weeks)
Review of the operating principle and their uses
Dimensioning of a synchronous machine, Selection of the winding.

Bibliographic references:
1. http://elearning.vtu.ac.in/06EE63.html
2. Transformers design, A. Dymkov, Mir Bublishers, Moscow, 1975
3. Calculation of electrical machines. Volumes I and II / M. Liwschitz Dunod / cop. 1967 1970
4. Design of Three-Phase Asynchronous Motors, BOUCHARD & OLIVIER, École Polytechnique de Montréal, 1997
5. Design of Rotating Electrical Machines, 2nd Edition, Juha Pyrhonen, Tapani Jokinen, Valeria Hrabovcova, ISBN: 978-1-118-70165-2, September 2013, 616 pages
6. Industrial Theory of Electricity and Electrical Machines, by A. Verdurand, 1919
7. The Construction of Electrical Machines, Julien Dalemont, Librairie Polytechnique, 1907-138 *pages.*

Semestre: 5
Teachin unit : UET 3.1
Matière 1: Simulation software
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:
Understand simulation software and be able to reproduce an electro-energetic system for study and simulation.

Recommended Prior Knowledge:
Programming skills, Matlab skills.

Subject Content:

Chapter 1: Getting Started with MATLAB (2 weeks)
1.1 - Introduction
1.2 - MATLAB Environment
1.3 - Starting MATLAB
Command Window, Defined Variables Window (Workspace), Working Directory Window, Command History Window
1.4 - Overview and General Information
Getting Help, Getting Started, The Workspace, Single-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 (2 weeks)
2.1 - Data Types
2.2 - Variables
Complex Numbers, Boolean Variables, Strings, Vectors, Matrices, Polynomials. Chapter 3: Graphics (1 week)
3.1 - Managing Graphics Windows
3.2 - 2D Graphics Representation
Cartesian Coordinate Graphics, Improving Figure Readability, Polar Coordinate Graphics, Diagrams.
3.3 - 3D Graphics
3D Curves, Surfaces

Chapter 4: Programming in MATLAB (2 weeks)
4.1 - Arithmetic and Logic Operators and Special Characters
4.2 - M-Files
4.3 - Scripts and Functions
(Scripts, Functions)
4.4 - Control Statements
(FOR Loop, WHILE Loop, Conditional IF Statement)
Chapter 5: Getting Started with SIMULINK (3 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, etc.

5.2 - Quick Start

5.3 - Masks and Subsystems

5.2.1 - Subsystems

5.3.2 - Subsystem Masking

Subsystem Masking, Using Callbacks

5.4 - Study of Some Simulation Examples

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

6.1 - Introduction to the Power System Blockset

6.2 - Study of a Simulation Example

Chapter 7: Simulation and Co-simulation with Other Software (3 weeks)

7.1 - Simulation with PSim and Simulink-PSim Co-simulation

7.2 - Simulation with Other Software: PSpice, Proteus, Scilab, etc.

<u>**Assessment Method:**</u>
<u>**Exam: 100%.**</u>

Bibliographic references:
    1. A. Lanton, "Simulation Methods and Tools," Edition, Hermès, 2000.
    2. Matlab Online Documentation

Course Objectives:

Understand, analyze, and model the machine-converter system, and wire the control and power circuits of electrical machines.

Recommended Prior Knowledge:

Electrical machines, static converters, servo systems, open-loop and closed-loop control.

Course Content:

Chapter 1. Introduction to Electrical Machine Control (1 Week)

Chapter 2. Static Converter Control (1 Week)

PWM Technique

Chapter 3. Speed Control of DC Machines (5 Weeks)

Review of DC machines (Operating Principle, Equivalent Wiring Diagram, Different Types of DC Machines), Electromechanical and Mechanical Characteristics of DC Machines, Mechanical Characteristics of Driven Loads, Operating Point of a Motor Set, Driven Load (Stability, Starting, Electrical Braking).

Methods for adjusting the speed of a shunt motor (rheostatic adjustment, flux adjustment, voltage adjustment).

Chapter 4. Speed Control of Asynchronous Motors (4 Weeks)

Reviews of asynchronous machines, Review of power electronic converters, Combining asynchronous machines (converters), Speed control of asynchronous motors (control by acting on the supply voltage, control by acting on the rotor resistance, control by hyposynchronous cascade, control by varying the supply frequency).

Chapter 5. Speed Control and Self-Control of Synchronous Motors (4 Weeks)

Review of synchronous machines, Synchronous machine combination (converters), Speed control of synchronous motors (principle of self-control of synchronous motors, speed control

of a self-controlled synchronous machine powered by a current switch, speed control of a self-controlled synchronous machine powered by a PWM voltage inverter).

Assessment method:

Continuous monitoring: 40%; Exam: 60%.

Bibliographic references:
1. R. Abdessemed, "Modeling and simulation of electrical machines", Ellipses, Collection, 2011.
2. M. Juferles, "Electric Drives: Design Methodology," Hermès, Lavoisier, 2010.
3. G. Guihéneuf, "Electric Motors Explained to Electronics Engineers. Implementations: Starting, Speed Variation, Braking," Publitronic, Elektor, 2014.
4. P. Mayé, "Industrial Electric Motors, Bachelor's, Master's, Engineering Schools," Dunod, Collection: Sciences Sup, 2011.
5. S. Smigel, "Modeling and Control of Three-Phase Motors. Vector Control of Synchronous Motors," 2000.
6. J. Bonal, G. Séguier, "Variable Speed Electric Drives." Vol. 2, Vol. 3

Course Objectives:

Understand the principle and structure of control loops. Choose the appropriate controller for an industrial process to achieve the required performance (stability, accuracy).

Recommended Prior Knowledge:

Knowledge of continuous linear servocontrol and general electricity.

Course Content:

Chapter 1. Introduction to Industrial Control (2 Weeks)

Industrial process concepts, components of a control loop (industrial process, actuators, sensors, controllers, signal conditioner, setpoint, measurement, disturbance, characteristic variables, controlling variables, controlled variables, disturbance variables), Schematic diagram of a controlled system, components of a control loop, symbols, functional diagrams and loops, performance criteria for a control system.

Chapter 2. On-Off Controller (2 Weeks)

On-Off Controller, On-Off Controller with Threshold, On-Off Controller with Hysteresis, On-Off Controller with Threshold and Hysteresis.

Chapter 3. Identification of Open and Closed Loop Systems (2 Weeks)

Purpose of identification, model selection, identification in open loops (S-curves, integrating curve, oscillatory curve), identification in closed loops (oscillation methods).

Chapter 4. Standard Controllers: P, PI, PD, PID (2 Weeks)

Characteristics, Structures of PID Controllers (parallel, series, mixed), Electronic and Pneumatic Designs.

Chapter 5. Selection and Sizing of Regulators (4 weeks)

Selection criteria, Sizing methods (flatness criterion, symmetrical criterion, Ziegler-Nichols method, etc.), Regulator adjustment by imposing a tracking model.

Chapter 6. Industrial Applications (3 weeks)

Temperature, flow, pressure, and level regulation.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. E. Dieulesaint, D. Royer, "Applied Control", 2001.
2. P. De Larminat, "Automation: Control of Linear Systems", Hermes, 1993.
3. K. J. Astrom, T. Hagglund, "PID Controllers: Theory, Design and Tuning", Instrument Society of America, Research Triangle Park, NC, 1995.
4. A. Datta, M. T. Ho, S. P. Bhattacharyya, "Structure and Synthesis of PID Controllers", Springer-Verlag, London, 2000.
5. Jean-Marie Flaus, "Industrial Regulation", Editions, Hermes, 1995.
6. P. Borne, "Analysis and Regulation of Industrial Processes Volume 1: Continuous Regulation", Editions Technip.
7. T. Hans, P. Guyenot, "Regulation and Servo Control" Editions, Eyrolles.
8. R. Longchamp, "Digital Control of Dynamic Systems: A Course in Automation," Presses Polytechniques et universitaires romandes, 2006.
9. http://www.technologuepro.com/cours-genie-electrique/cours-6-regulation-industrielle/.

Semester: 6
Teaching unit: UEF 3.2.2
Matter 1 : Industrial automation
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:
Master graphical representation tools for automated systems (Grafcet), install and maintain industrial automation components, and program and configure programmable logic controllers.

Recommended Prior Knowledge:
Basic knowledge of digital electronics and computer programming languages.

Course Content:
Chapter 1. Introduction to Automated Systems (3 Weeks)
Overall Function of a System, Automation and Structure of Automated Systems, Pre-Actuators (Contactors, Triacs, etc.), Actuators (Cylinders, Motors, etc.), Sensors, Classification of Automated Systems, Specification Levels, Functional Specification Representation Tools.

Chapter 2. Grafcet (3 Weeks)
Definition and basic concepts, Rules for establishing Grafcet, Transitions and oriented connections, Evolution rules, Sequence selection and simultaneous sequences, Organization of representation levels, Materialization of a Grafcet, Practical examples.

Chapter 3. Programmable Logic Controller (4 Weeks)
Internal structure and description of PLC elements, Selection of the processing unit, Selection of a programmable logic controller, Input-output interfaces, Graphical and textual programming tools, Implementation of a programmable logic controller, Principles of PLC networks.

Chapter 4. Start-Stop Mode Study Guide (GEMMA) (3 Weeks)
Concept and structure of GEMMA, Operating, shutdown, and fault procedures, Practical use of GEMMA and applications.

Chapter 5. Applications in Electrical Engineering (2 Weeks)
Automated DC Motor Startup, Automatic Start-Stop of Asynchronous and Synchronous Motors, Automation of Electromagnetic Protection of Electric Motors, Automation of Motor Protection Using Thermal Relays.

Assessment Method:
Continuous Assessment: 40%; Exam: 60%.

Bibliographic references:
1. Jean-Claude Humblot, "Programmable Industrial Automation", Hermès, 1993.
2. Sandre Serge, Jacquar Patrick, "Programmable Industrial Automation", Lavoisier, 1993.
3. P. Le Brun, "Programmable Automation", 1999.
4. Jean-Yves Fabert, "Automation and Automation", Ellipses, 2005.

5. William Bolton, "Programmable Industrial Automation", Dunod, 2009.

6. Khushdeep Goyal and Deepak Bhandari, "Industrial Automation and Robotics", Katson Books, 2008.

7. Gérard Boujat, Patrick Anaya, "Industrial Automation in 20 Fact Sheets", Dunod, 2013.

8. Simon Moreno, Edmond Peulot, "Grafcet: Design and Implementation in Programmable Automation" Industrial Automation", Edition Casteilla 2009.

9. G. Michel, "APIs: Architecture and Applications of Industrial Programmable Logic Controllers", Edition Dunod, 1988.

10. William Bolton, "Industrial Programmable Logic Controllers", Edition Dunod, 2010.

11. Frederic P. Miller, Agnes F. Vandome, John McBrewster, "Industrial Programmable Logic Controllers: Computer Programming, Automation, Industry, Programming (Computer), Switch, Automation Engineer", Edition Alphascript Publishing, 2010.

Semester: 6
Teaching unit : UEF 3.2.2
Matter 2: Materials and Introduction to High Voltage
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

<u>Learning Objectives:</u>
Choose the appropriate material based on its operating conditions and environment.

<u>Recommended Prior Knowledge:</u>
Construction of matter, electric field theory, and disruptive electric discharge.

<u>Course Content:</u>
Part I - Electrotechnical Materials
Chapter 1. Conductive Materials (1 Week)
Basic Concepts, Classification of Conductors and Properties According to Their Use.

Chapter 2. Magnetic Materials (3 Weeks)
Magnetism at the Microscopic and Macroscopic Scales, Classification of Magnetic Materials, Magnetization Mechanisms and Technical Characteristics of Magnetization, Soft Ferromagnetic Materials, Areas of Use, Hard Ferromagnetic Materials, Characteristics and Areas of Application of Permanent Magnets, Concepts of Energy in Magnetic Materials, Magnetic Losses, Measurement of Losses in Fixed and Rotating Fields.

Chapter 3. Dielectric Materials (2 Weeks)
Polarization Phenomena, Resistivity, Dielectric Strength and Dielectric Losses, Physicomechanical Properties, Electrically Insulating Materials.

Chapter 4. Semiconductor Materials (1 Week)
General Information on Semiconductors and Their Applications.

Chapter 5. Superconducting Materials (1 Week)
General Information on Superconductors and Their Applications.

Part II - Introduction to High Voltage
Chapter 1. General Information on High Voltage (1 Week)
Voltage Ranges, Usefulness of High Voltage, Selection of HV Equipment, Technological and Industrial Applications of High Voltage

Chapter 2. General Information on HV Stresses (2 Weeks)
Purposes and Methodology of HV, Voltage-Related Stresses, Current-Related Stresses, Overvoltage and Overcurrent Protection.

Chapter 3. High Voltage Measurement (2 Weeks)
High Voltage Sources, High Voltage Measurement.

Chapter 4: High Voltage Transient Phenomena (2 Weeks)

Origins of Overvoltages, Lightning Phenomenon and Impact on Electrical Installations, Switching Overvoltages, Different Protection Techniques

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Bibliographic References:

1. P. Robert, "Matériaux de l'électrotechnique", Dunod.
2. F. Piriou, "Matériaux du génie électrique", MGE 2000, Germes.
3. Gérald Roosen, "Matériaux semi-conducteurs et nitrures pour l'optoélectronique", Hermès.
4. P. Tixador, "Matériaux supraconducteurs", Hermès.
5. M. Aguet, "M. Ianovici, Haute Tension", vol XXII, Edition Georgi, 1982.
6. G. LeRoy, C. Gary, B. Hutzler, J. Hamelin, J. Fontaine, "Les propriétés diélectriques de l'air et les très hautes tensions", Editions Eyrolles, 1984.

1. D. Kind, H. Kärner. "High voltage insulation technology: Textbook for Electrical Engineers", FriedrVieweg&Sohn, 1985.
2. J. P. Holtzhausen, W. L. Vosloo, "High Voltage Engineering, Practice and Theory".
3. André Faussurier, Robert Servan, "Matériaux en électrotechnique", Dunod Paris, 1971.
4. A. Chabloz, "Technologie des matériaux", Suisse 1980.

Semester: 6
Teaching unit: UEM 3.2
Matière 1: End of Cycle Project
VHS: 45h00 (TP: 3h00)
Credits: 4
Coefficient: 2

Teaching Objectives:

To comprehensively and complementaryly assimilate knowledge from different subjects. To concretely apply the concepts taught during the program. To encourage students' sense of autonomy and initiative. To teach them to work in a collaborative environment by fostering intellectual curiosity.

Recommended Prior Knowledge:

The entire Bachelor's program.

Subject Content:

The theme of the Final Year Project must be the result of a joint decision between the tutor and a student (or a group of students: in pairs or even in threes). The content of the topic must be consistent with the program objectives and the student's actual abilities (Bachelor's level). It is also preferable for this theme to take into account the institution's social and economic environment. When the nature of the project requires it, it may be subdivided into several parts.

Notes:

During the weeks when students are familiarizing themselves with the purpose of their project and its feasibility (bibliographic research, searching for software or hardware needed to conduct the project, reviewing and consolidating lessons directly related to the topic, etc.), the subject leader must use this in-person 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 core curriculum.

At the end of this study, students must submit a written report in which they must present as clearly as possible:
- A detailed presentation of the study topic, emphasizing its relevance to the socioeconomic environment.
- The resources implemented: methodological tools, bibliographic references, contacts with professionals, etc.
- An analysis of the results obtained and their comparison with the initial objectives. - Critique any discrepancies noted and possibly present additional details.
- Identify any difficulties encountered, highlighting the limitations of the work completed and the follow-up actions to be taken.

Finally, the student or group of students presents their work (in the form of a brief oral presentation or on a poster) to their tutor and an examiner, who may ask questions and thus assess the work accomplished in terms of both technique and presentation.

Mode d'évaluation:
Contrôle continu: 100%.

Course Objectives:
Discover the different types of variable-speed drives for electrical machines and their electromechanical characteristics.

Recommended Prior Knowledge:
The basic principles of electrical engineering and the characteristics of electrical machines.

Course Content:

PW 1: Starting a DC Motor

PW 2: Combining a Bidirectional Rectifier with a DC Machine

PW 3: Combining a Chopper with a DC Machine

PW 4: Combining an Inverter with an AC Machine

PW 5: Combining a Frequency Converter with an AC Machine

PW 6: Studying Stepper Motor Control

Assessment Method:
Continuous Control: 100%.

Bibliographic References:
Lecture notes on electrical machines, power electronics, and control.

Semester : 6
Teaching unit: UEM 3.2
Matter 3: PW Industrial regulation
VHS: 22h30 (PW: 1h30)
Crédits: 2
Coefficient: 1

Course Objectives:
Manipulate control loops, compare practical and theoretical parameters.

Recommended Prior Knowledge:
Controlled systems and control courses.

Course Content:

PW 1: Frequency Responses and System Identification.

PW 2: Controller Characteristics.

PW 3: Analog (PID) Fluid Level Control.

PW 4: Speed Control of an MCC Motor.

PW 5: Pressure Control.

PW 6: Temperature Control.

Assessment Method:
Continuous Assessment: 100%

Literature References:
Laboratory Work Brochure, Lecture Notes, Lab Documentation.

Semester : 6
Teaching unit: UEM 3.2
Matter 4: PW Automation / PW Materials and HT
VHS: 22h30 (TP: 1h30)
Crédits: 2
Coefficient: 1

Course Objectives:
Perform experiments to broaden knowledge of industrial automation. Be able to select and characterize an unknown material.

Recommended Prior Knowledge:
Course Content.

Subject Content:

Laboratory Work: Industrial Automation

Laboratory Work 1: Introduction to Grafcet or other automation language (1 week)
Laboratory Work 2: Familiarization with automation software (e.g., Automgen or other software) (1 week)
Laboratory Work 3: Convergence and Divergence in AND and OR (2 weeks)
Laboratory Work 4: Timing (1 week)
Laboratory Work 5: Counters (1 week)
Laboratory Work 6: Grafcet of an Automatic Drilling Station (1 week)
Laboratory Work 7: Grafcet of a Bottle Filling System (1 week)
Laboratory Work 8: Grafcet of a Direct-on-Line Starting of a Three-Phase Motor in Both Directions of Rotation (2 weeks)

Laboratory Work: Materials and Introduction to HV
Measurement of the Transverse Dielectric Strength of a Gas, Solid, and Liquid, Characterization of the Longitudinal Dielectric Strength of an Insulation Based on its Surface Condition (Clean or Polluted), Measurement of the surface, volume, and insulation resistance of an insulator; determination of the relative permittivity, capacitance, and dielectric losses of solid and liquid insulation.

Assessment method:
Continuous assessment: 100%.

Bibliographic references:
Lecture notes and lab brochures.

Course Objectives:

To become familiar with the various processes and techniques for protecting electrical networks and their components against various stresses and to ensure better protection.

Recommended Prior Knowledge:

Fundamentals of electricity, Equivalent circuit diagrams of electrical circuits, Electrical power networks (construction, modeling, and calculations).

Course Content:

Chapter 1. Introduction to Protection (4 weeks)

General concepts of the main faults that can occur in an electrical power network, Measuring devices and reduction of electrical quantities characterizing different faults (current transformer, potential transformer, impedance measurement, power measurement, symmetrical current and voltage component filters, etc.), General information on protection (Definitions; Selectivity; Sensitivity; Speed and reliability), Amperometric and volumetric protection, Selectivity mode.

Chapter 2: Review of Symmetrical Components and Fault Currents (3 weeks)

Definition of symmetrical components, Transformation of load impedances into symmetrical components, Symmetrical components of "series" impedances, Equivalent single-phase diagrams of rotating machine sequences, Expression of apparent power in symmetrical components, Equivalent diagrams (direct, negative sequence, and zero sequence, relationships between different types of faults)

Chapter 3. Protection System Elements (3 weeks)

Principal structural model, Technology – operation and applications of different types of relays (current relays, voltage relays, current differential relays, directional power relays, distance relays, etc.), Voltage and current transformation.

Chapter 4. Protection of Network Elements (5 weeks)

Alternator and motor protection, Busbar protection, Transformer protection, Line protection, distance and differential.

Assessment method:
Exam: 100%

Bibliographic references:
1. Hadi Saadat, "Power System Analysis," Edition 2, 2004.
2. Furan Gonon, "Electric Power Distribution System Engineering," Edition, 1980.

3. Christophe Prévé, "Protection of Electrical Networks," Hermes Paris, 1998.

4. S. H. Horowitz, A. G. Phadke, "Power System Relaying," Second Edition, John Wiley & Sons, 1995.

5. L. Féchant, "LV Electrical Switchgear, Distribution Devices," Engineering Techniques, Electrical Engineering Treatise, D 4 865.

6. S. Vacquié, A. Lefort, "Physical Study of the Electric Arc, The Electric Arc and Its Applications," Volume 1, CNR ed., S 1984.

Semester: 6
Teaching unit: UED 3.2
Matter 2: Industrial maintenance
VHS : 22h30 (Course : 1h30)
Credits: 1
Coefficient: 1

Course Objectives:

Ensure the continuity of service of an industrial facility, identify the functions and components of electrical and electronic equipment, determine the causes of system failure, and repair them.

Recommended Prior Knowledge:

Statistics, apparatus, measurements, and instrumentation.

Course Content:

Chapter 1. General Information on Maintenance (4 Weeks)

History (standardized concepts and terminology, etc.), Role of equipment maintenance and troubleshooting in industry, Elements of mathematics applied to maintenance, Behavior of equipment in service, Failure rates and reliability laws, Reliability models, Different forms of maintenance, Organization of maintenance and troubleshooting of electrical equipment, Classification of planned maintenance of electrical equipment.

Chapter 2. Maintenance Organization and Management (4 Weeks)

Structure of workshops specializing in troubleshooting electromechanical converters, Organization of maintenance operations, Main steps in troubleshooting technology for electrical machines, Study of various electrical machine faults and methods for detecting them, Disassembly and reassembly techniques, Testing and diagnostics prior to troubleshooting.

Chapter 3. Troubleshooting Different Parts of Electrical Machines (4 Weeks)

Troubleshooting the mechanical part, Troubleshooting the electrical part, Calculation and verification of electro-energetic system parameters, Recalculation of electro-energetic systems using other nameplate data, Assembly work and testing methods after troubleshooting.

Chapter 4. General Information on Computer-Aided Maintenance (CAM) (3 Weeks)

Assessment Method:

Exam: 100%

Bibliographic References:

1. G. Zwingelstein, "Failure Diagnosis", Hermès, Paris, 1997.
2. "Reliability-Based Maintenance", Hermès, Paris, 1997.
3. Jean Henq, "Preventive Maintenance Practice", Dunod, 2000.
4. Raymond Magnan, "Industrial Maintenance Practice", Dunod, 2003.
5. Yves Lavina, "Industrial Maintenance, Function of the Company", 2005.
6. M. François, "Maintenance: Method and Organization", Dunod, Paris, 2000.
7. M. François, "Maintenance: Method and Organization", Dunod, Paris, 2000.
8. A. Boulenger, C. Pachaud, "Vibration Diagnosis in Preventive Maintenance", Dunod, Paris, 2000.
9. Jean Henq, "Preventive Maintenance Practice", Dunod, Paris, 2002.
10. R. Cuigent, "Maintenance Management", Dunod, Paris, 2002.
11. Rachid Chaib, "Maintenance and Industrial Safety in the Company", Dar El Houda, Algiers, 2007.
12. S. Robert, S. Stéphane, "Maintenance: The MAXER Method", Dunod, Paris, 2008.
13. J. F. D. Beaufort, "Use of Relays for the Protection of Installations", 1972.
14. Michel Pierre Villoz, "Protection and the Environment", Technique et ingénieur, 2006.
15. Nichon Margossian, "Occupational Risks", Technique et ingénieur, 2006.

Teaching 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.

Course Content:

Chapter 1: Introduction to Entrepreneurship (2 weeks)
   • Definition and interrelationship between entrepreneurship and innovation
   • The entrepreneurial and innovation ecosystem in Algeria
   • The different types of innovation (product, process, business model)
   • Profile and skills of the innovative entrepreneur From idea to project
   • Identifying opportunities
   • Creativity techniques (brainstorming, mind mapping, etc.)
   • Case study: failure vs. success
Chapter 2: Identifying Innovative Opportunities (1 week)
   • Methods for detecting innovation opportunities
   • Analysis of unmet needs in the Algerian market
   • Design thinking and user-centered approach
   • Creativity and ideation techniques
Chapter 3: Business Model Canvas (3 weeks)
   • Components of the Business Model Canvas
   • Developing the value proposition
   • Customer segmentation
   • Distribution channels and customer relationship management
   • Cost structure and revenue streams
   • Developing disruptive business models
Chapter 4: Introduction to the Business Plan (2 weeks)
   • Structure and key elements of the business plan
   • Simplified market research
   • Marketing and sales strategy
   • Fundamental financial aspects
   • SWOT analysis
   • Marketing plan, operational plan
Chapter 5: Startup Financing (3 weeks)
   • Available Funding Sources in Algeria
   • Public Entrepreneurship Support Programs (ANSEJ, incubators, accelerators, CNAC, ANGEM)
   • Venture Capital and Business Angels
   • Crowdfunding
   • Intellectual Property Protection

- Tax Advantages and Specific Support for Innovative Startups

Chapter 6: Communication and Leadership (1 week)
- Oral Presentation Techniques
- Teamwork, Conflict Management

Chapter 7: Legal and Administrative Aspects (1 week)
- Legal Structures of Businesses in Algeria
- Administrative Procedures for Business Creation
- Intellectual Property Protection
- Startup Taxation

Chapter 8: From Concept to Implementation - Implementing the Innovative Project (2 weeks)
- Developing a Minimum Viable Product (MVP)
- Testing and Validating the Innovation in the Market
- Development of a growth strategy
- Effective presentation of an innovative project (pitch)

Assessment Method: Exam: 100%

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

IV- Agreements / Conventions

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 university (or university center) hereby declares its co-sponsorship of the above-mentioned degree program throughout the accreditation period.

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

- Providing input into the development and updating of teaching programs,
- Participating in seminars organized for this purpose,
- Participating in thesis defense juries,
- Working to pool human and material resources.

SIGNATURE of the legally authorized person:

POSITION:

Date:

SAMPLE LETTER OF INTENT

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

(Official letterhead on the company's letterhead)

PURPOSE: Approval of the project to launch a Bachelor's degree program entitled:

Delivered to:

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

To this end, we confirm our commitment to this project, and our role will be to:

- Provide our perspective in the development and updating of the curriculum,

- Participate in seminars organized for this purpose,

- Participate in thesis defense juries,

- Facilitate as much as possible the hosting of interns, either for final dissertations or for supervised projects.

The necessary resources will be deployed to carry out the tasks assigned to us to achieve these objectives, both materially and humanly.

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

SIGNATURE of the legally authorized person:

POSITION:

Date:

OFFICIAL STAMP or COMPANY SEAL

V - Opinions and Visas of the Administrative and Consultative Bodies

License Title : Electrotechnical

Department Head + Domain Team Leader
Date and visa: Date and visa:

Doyen de la faculté (ou Directeur d'institut)
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