Licence in Branch: Electrotechnical

Speciality:Electrotechnical

Brief

electrical engineering in all its segments (production, transmission, distribution, conversion and control) has occupied a primordial place in the industrial sector of the countries and continues to be the object of particular attention, scientific investment and continuous technological improvement .
The training is structured in 6 semesters, the first two of which (Common Base) concern all students in the Science and Technology field. The third semester constitutes a pre-specialization and brings together all the students of the Electrical Engineering family. From semester 4, the lessons become specialized and are mainly oriented towards Electrotechnical.

Field	Branch	Speciality
Sciences and Technologies	**Electrotechnical**	**Electrotechnical**

First Semester

Teaching unit	Matter	Credit	Coefficient	Course	TD	TP	HV
FundamentalUnit	Mathematics 1	6	3	3h00	1h30		67h30
	Physics 1	6	3	3h00	1h30		67h30
	Structure of matter	6	3	3h00	1h30		67h30
Methodological unit	TP Physics 1	2	1			1h30	22h30
	TP Chemistry 1	2	1			1h30	22h30
	Computer science 1	4	2	1h30		1h30	45h00
	Writing methodology	1	1	1h00			15h00
Discovery unit	Professions in Science and Technology 1	1	1	1h30			22h30
Transversale Unit	Ethical and deontological	1	1	1h30			22h30

Teaching unit	Matter	Credit	Coefficient	Course	TD	TP	HV
	dimension (the foundations)						
	Foreign language 1 (French or English)	1	1	1h30			22h30

Second Semester 2

Teaching unit	Matter	Credit	Coefficient	Courses	TD	Practical Work	Volume (hour)
Fundamental Unit	Mathematics 2	6	3	3h00	1h30		67h30
	Physics 2	6	3	3h00	1h30		67h30
	Thermodynamics	6	3	3h00	1h30		67h30
Methodological unit	TP Physics 2	2	1			1h30	22h30
	TP Chemistry 2	2	1			1h30	22h30
	Computer science 2	4	2	1h30		1h30	45h00
	Presentation methodology	1	1	1h00			15h00
Discovery unit	Professions in Science and Technology 2	1	1	1h30			22h30
Transversale Unit	Foreign language 2 (French and/or English)	2	2	3h			45h00

Third Semester

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
Fundamental Unit FU 2.1.1	Mathematics 3	6	3	3h00	1h30		67h30
	Waves and vibrations	4	2	1h30	1h30		45h00

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
Fundamental Unit FU 2.1.2	Fundamental Electronics 1	4	2	1h30	1h30		45h00
	Fundamental electrotechnics 1	4	2	1h30	1h30		45h00
Methodological unit	Probability and statistics	4	2	1h30	1h30		45h00
	Computer science 3	2	1			1h30	22h30
	TP Electronics and electrotechnics	2	1			1h30	22h30
	TP Waves and vibrations	1	1			1h00	15h00
Discovery unit	State of the art of electrical engineering	1	1	1h30			22h30
	Energy and environment	1	1	1h30			22h30
Transversale Unit	Technical English	1	1	1h30			22h30

Fourth semester

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
Fundamental Unit	Fundamental electrotechnics 2	6	3	3h00	1h30		67h30
	Combinatorial and sequential logic	4	2	1h30	1h30		45h00
	Numerical methods	4	2	1h30	1h30		45h00
	Signal theory	4	2	1h30	1h30		45h00
Methodological unit	Electrical and electronic	3	2	1h30		1h00	37h30

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
	measurements						
	TP Fundamental electrotechnics	2	1			1h30	22h30
	TP Combinatorial logic and sequential	2	1			1h30	22h30
	TP Numerical methods	2	1			1h30	22h30
Discovery unit	Production of electrical energy	1	1	1h30			22h30
	Electrical Safety	1	1	1h30			22h30
Transversale Unit	Techniques of expression, information and communication	1	1	1h30			22h30

Fifth semester

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
Fundamental Unit	Electrical Networks	6	3	3h00	1h30		67h30
	Power Electronics	4	2	1h30	1h30		45h00
	Servo Systems	4	2	1h30	1h30		45h00
	Electromagnetic Field Theory	4	2	1h30	1h30		45h00
Methodological unit	Diagrams and electrical equipment	3	2	1h30		1h00	37h30
	TP Electrical Networks	2	1			1h30	22h30
	TP Power Electronics	2	1			1h30	22h30
	TP Servo	2	1			1h30	22h30

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
	systems/ TP sensors						
Discovery unit	Sensors and Metrology	1	1	1h30			22h30
	Design of electrical systems	1	1	1h30			22h30
Transversale Unit	Simulation software	1	1	1h30			22h30

Six Semester

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
Fundamental Unit	Control of electrical machines	6	3	3h00	1h30		67h30
	Industrial regulation	4	2	1h30	1h30		45h00
	Industrial Automation	4	2	1h30	1h30		45h00
	Materials and introduction to High Voltage	4	2	1h30	1h30		45h00
Methodological unit	final project	4	2		3h00		45h00
	TP Machine control	1	1			1h00	15h00
	TP Industrial Regulation	2	1			1h30	22h30
	TP Automation/ Materials and HV	2	1			1h30	22h30
Discovery unit	Protection of electrical networks	1	1	1h30			22h30
	Industrial maintenance	1	1	1h30			22h30

Teaching unit	Matter	Credit	Coefficient	C	TD	TP	HV
Transversale Unit	Entrepreneurship and business management	1	1	1h30			22h30

III - Detailed program by subject

Semester: 1
Course unit: UEF 1.1
Subject 1: Mathematics 1
VHS: 67h30 (Class: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives
This first subject of mathematics is particularly devoted to the homogenization of the level of students at the entrance of the 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.

Prior knowledge recommended
Basic notions of mathematics for the Terminale classes (sets, functions, equations, etc.).

Material content:

Chapter 1. Methods of Mathematical Reasoning (1 Week)
1-1 Direct reasoning. 1-2 Reasoning by contraposition. 1-3 Absurd reasoning. 1-4 Reasoning by counterexample. 1-5 Inductive reasoning.

Chapter 2. Sets, Relations and Maps (2 Weeks)
2.1 Set theory. 2-2 Order relation, Equivalence relations. 2-3 Injective, surjective, bijective map: definition of a map, direct image, reciprocal image, characteristic of a map.

Chapter 3. Real functions in one real variable (3 Weeks)
3-1 Limit, continuity of a function. 3-2 Derivative and differentiability of a function.

Chapter 4. Application to Elementary Functions (3 Weeks)
4-1 Power function. 4-2 Logarithmic function. 4-3 Exponential function. 4-4 Hyperbolic function. 4-5 Trigonometric function. 4-6 Inverse function

Chapter 5. Limited Development (2 Weeks)
5-1 Taylor formula. 5-2 Limited development. 5-3 Applications.

Chapter 6. Linear Algebra (4 Weeks)
6-1 Laws and internal composition. 6-2 Vector space, basis, dimension (definitions and elementary properties). 6-3 Linear mapping, kernel, image, rank.

Assessment method:
Continuous control: 40%; Review: 60%.

Bibliographic references:

1- K. Allab, Eléments d'analyse, Fonction d'une variable réelle, 1re& 2e années d'université, Office des Publications universitaires.

2- J. Rivaud, Algèbre : Classes préparatoires et Université Tome 1, Exercices avec solutions, Vuibert.

3- N. Faddeev, I. Sominski, Recueil d'exercices d'algèbre supérieure, Edition de Moscou

4- M. Balabne, M. Duflo, M. Frish, D. Guegan, Géométrie – 2e année du 1er cycle classes préparatoires, Vuibert Université.

5- B. Calvo, J. Doyen, A. Calvo, F. Boshet, Exercices d'algèbre, 1er cycle scientifique préparation aux grandes écoles 2e année, Armand Colin – Collection U.

6- J. Quinet, Cours élémentaire de mathématiques supérieures 1- Algèbre, Dunod.

7- J. Quinet, Cours élémentaire de mathématiques supérieures 2- Fonctions usuelles, Dunod.

8- J. Quinet, Cours élémentaire de mathématiques supérieures 3- Calcul intégral et séries, Dunod.

9- J. Quinet, Cours élémentaire de mathématiques supérieures 4- Equations différentielles, Dunod.

Semester: 1
Course unit: UEF 1.1
Subject 2: Physics 1
VHS: 67h30 (Class: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives
Introduce the student to the basics of Newtonian physics through three main parts: Kinematics, Dynamics and Work and Energy.
Prior knowledge recommended
Notions of mathematics and physics.

Material content:

Math Reminders (2 Weeks)
1- The dimensional equations
2- Vector calculus: scalar product (norm), vector product, Functions with several variables, derivation. Vector analysis: gradient, rotational, etc. operators

Chapter 1. Kinematics (5 Weeks)
1- Position vector in coordinate systems (Cartesian, cylindrical, spherical, curvilinear)- law of motion – Trajectory. 2- Velocity and acceleration in coordinate systems. 3- Applications: Motion of the material point in the different coordinate systems. 4- Relative movement.

Chapter 2. Dynamic: (4 Weeks)
1- Generality: Mass - Force - Moment of force – Absolute and Galilean reference. 2- Newton's laws. 3- Principle of conservation of momentum. 4- Differential equation of motion. 5- Kinetic moment. 6- Applications of the fundamental law for forces (constant, time-dependent, speed-dependent, central force, etc.).

Chapter 3. Work and Energy (4 Weeks)
1- Work of a force. 2- Kinetic Energy. 3- Potential energy – Examples of potential energy (gravity, gravitational, elastic). 4- Conservative and non-conservative forces - Total energy theorem.

Assessment method:
Continuous control: 40%; Review: 60%.

Bibliographic references:
1. A.Gibaud**,** M. Henry ; Cours de physique - Mécanique du point - Cours et exercices corrigés; Dunod, 2007.
2. P. Fishbane et al. ; Physics For Scientists and Engineers with Modern Physics, 3rd Ed. ; 2005.

3. P. A. Tipler, G. Mosca ; Physics For Scientists and Engineers, 6th Ed., W. H. Freeman Company, 2008.

Semester: 1
Course unit: UEF 1.1
Matter 3: Structure of Matter
VHS: 67h30 (Class: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives
The teaching of this subject allows the student to acquire basic formalisms in chemistry, particularly within the subject describing the atom and the chemical bond, the chemical elements and the periodic table with energy quantification. Make students more adept at solving chemistry problems.

Prior knowledge recommended
Basic notions of mathematics and general chemistry.

Material content:

Chapter 1: Fundamentals (2 Weeks)
States and macroscopic characteristics of the states of matter, changes of state of matter, notions of atom, molecule, mole and Avogadro's number, atomic mass unit, atomic and molecular molar mass, molar volume, Law of weight: Conservation of mass (Lavoisier), chemical reaction, Qualitative aspect of matter, Quantitative aspect of matter.

Chapter 2: Main constituents of matter (3 Weeks)
Introduction: Faraday's experiment: relationship between matter and electricity, Highlighting the constituents of matter and therefore of the atom, and some physical properties (mass and charge), Rutherford's planetary model, Presentation and characteristics of the atom (Symbol, atomic number Z, mass number A, number of protons, neutrons and electrons), Isotopy and relative abundance of the various isotopes, Separation of isotopes and determination of the atomic mass and the average mass of an atom: Mass spectrometry: Bainbridge spectrograph, Binding and cohesion energy of nuclei, Stability of nuclei.

Chapter 3: Radioactivity – Nuclear Reactions (2 Weeks)
Natural radioactivity (α, β and γ radiation), Artificial radioactivity and nuclear reactions, Kinetics of radioactive decay, Applications of radioactivity.

Chapter 4: Electronic Structure of the Atom (2 Weeks)
Wave-particle duality, Interaction between light and matter, Bohr atomic model: hydrogen atom, The hydrogen atom in wave mechanics, Polyelectronic atoms in wave mechanics.

Chapter 5: Periodic Table of Elements (3 Weeks)
D. Mendeleiev's periodic table, Modern periodic table, Evolution and periodicity of the physico-chemical properties of the elements, Calculation of the radii (atomic and ionic), successive ionization energies, electron affinity and electronegativity (Mulliken scale) by Slater's rules.

Chapter 6: Chemical Bonds (3 Weeks)
The covalent bond in the Lewis theory, The polarized covalent bond, dipole moment and partial ionic character of the bond, Molecular geometry: Gillespie theory or VSEPR, The chemical bond in the quantum model.

Assessment method:
Continuous control: 40%; Review: 60%.

Bibliographic references

1. Ouahes, Devallez, Chimie Générale, OPU.

2. S.S. Zumdhal & coll., Chimie Générale, De Boeck Université.

3. Y. Jean, Structure électronique des molécules : 1 de l'atome aux molécules simples, 3e édition, Dunod, 2003.

4. F. Vassaux, La chimie en IUT et BTS.

5. A. Casalot & A. Durupthy, Chimie inorganique cours 2ème cycle, Hachette.

6. P. Arnaud, Cours de Chimie Physique, Ed. Dunod.

7. M. Guymont, Structure de la matière, Belin Coll., 2003.

8. G. Devore, Chimie générale : T1, étude des structures, Coll. Vuibert, 1980.

9. M. Karapetiantz, Constitution de la matière, Ed. Mir, 1980.

Semester: 1
Course unit: UEM 1.1
Subject 1: Physics 1
VHS: 10:30 p.m. (PT: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives
Consolidate the theoretical knowledge brought to the course by a certain number of practical manipulations.

Prior knowledge recommended
Notions of mathematics and physics.

Material content:

5 manipulations at least (3h00 / 15 days):

- Methodology of presentation of practical work reports and calculation of errors.
- Verification of Newton's 2nd law
- Free fall
- Simple pendulum
- Elastic collisions
- Inelastic collisions
- Moment of inertia
- Centrifugal force

Assessment method:
Continuous control: 100%.

Semester: 1
Course unit: UEM 1.1
Subject 2: Lab Chemistry 1
VHS: 10:30 p.m. (PT: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives
Consolidate the theoretical knowledge brought to the structure of matter course by a certain number of practical manipulations.

Prior knowledge recommended
Notions of basic chemistry.

Material content:

1. Safety in the laboratory

2. Preparation of solutions

3. Notions on uncertainty calculations applied to chemistry.

4. Acid-base determination by colorimetry and pH-metry.

5. Acid-base determination by conductivity meter.

5. Redox assay

6. Determination of water hardness

7. Determination of ions in water: determination of chloride ions by the Mohr method.

Assessment method:
Continuous control: 100%

Semester: 1
Course unit: UEM 1.1
Subject 3: Computer Science 1
VHS: 45h00 (Class: 1h30, Lab: 1h30)
Credits: 4
Coefficient: 2

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

Prior knowledge recommended
Basics of web technology.

Material content:
Part 1. Introduction to Computers (5 Weeks)
1- Definition of IT
2- Evolution of IT and computers
3- Information coding systems
4- Operating principle of a computer
5- Hardware part of a computer
6- System part
Basic systems (operating systems (Windows, Linux, Mac OS, etc.)
Programming languages, application software

Part 2. Notions of algorithm and program (10 Weeks)
1- Concept of an algorithm
2- Organization chart representation
3- Structure of a program
4- The approach and analysis of a problem
5- Data structure: Constants and variables, Data types
6- Operators: assignment operator, Relational operators, Logical operators, Arithmetic operations, Priorities in operations
7- Entry/exit operations
8- Control structures: Conditional control structures, Repetitive control structures

Computer lab 1:
The practicals aim to illustrate the notions taught during the course. The latter must begin with the lessons according to the following schedule:
• Initiation and familiarization with the computer machine from a hardware and operating systems point of view (exploration of the different functionalities of the OS)
• Introduction to the use of a programming environment (Editing, Assembly, Compilation, etc.)
• Practical application of the programming techniques seen in class.

Assessment method:
Continuous control: 40%; Review: 60%.

Bibliographic references

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

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

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

Semester: 1
Course unit: UEM 1.1
Topic 4: Writing Methodology
VHS: 3:00 p.m. (Class: 1:00 a.m.)
Credits: 1
Coefficient: 1

Teaching objectives
Familiarize and train students with current concepts of writing methodology in force in the profession of Science and Technology. Among the skills to be acquired: Knowing how to introduce yourself; Know how to write a CV and a cover letter; Knowing how to position oneself in writing or orally in relation to an opinion or an idea; Mastering syntax and spelling in writing.

Prior knowledge recommended
Basic French. Basic principle of writing a document.

Material content:
Chapter 1. Notions and generalities on writing techniques (2 Weeks)
– Definitions, standards
- Applications: writing a summary, a letter, a request

Chapter 2. Information Search, Synthesis and Exploitation (3 Weeks)
- Search for information in the library (Paper format: Books, Journals)
-Search for information on the Internet (Digital: Databases; Search engines, etc.).
- Apps

Chapter 3 Writing Techniques and Procedures (3 Weeks)
- Basic principle of writing - Punctuation, Syntax, Sentences
- sentence length
- Division into paragraphs
- The use of a neutral style and writing in the third person
- Readability
- Objectivity
- Intellectual rigor and Plagiarism

Chapter 4 Writing a Report (4 Weeks)
Cover pages, Summary, Introduction, Method, Results, Discussion, Conclusion, Bibliography, Appendices, Summary and Keywords

Chapter 5. Applications (3 Weeks)
Report of a practical work

Assessment method:
Control Review: 100%.

Bibliographic references:

1. J.-L. Lebrun, Guide pratique de rédaction scientifique, EDP Sciences, 2007.

2. M. Fayet, Réussir ses comptes rendus, 3e édition, Eyrolles, 2009.

3. M. Kalika, Mémoire de master - Piloter un mémoire, Rédiger un rapport, Préparer une soutenance, Dunod, 2016.

4. M. Greuter, Réussir son mémoire et son rapport de stage, l'Etudiant, 2014

5. F. Cartier, Communication écrite et orale, Edition GEP- Groupe Eyrolles, 2012.

6. M. Fayet, Méthodes de communication écrite et orale, 3e édition, Dunod, 2008.

7. E. Riondet, P. Lenormand, Le grand livre des modèles de lettres, Eyrolles, 2012.

8. R. Barrass, Scientist must write – A guide to better writing for scientists, engineers and students, 2d edition, Routledge, 2002.

9. G. Andreani, La pratique de la correspondance, Hachette, 1995.

10. Ph. Rubens, Science & Technical Writing, A Manual of Style, 2d edition, Routledge, 2001.

11. A. Wallwork, User Guides, Manuals, and Technical Writing – A Guide to Professionnal English, Springer, 2014.

Semester: 1
Course unit: UED 1.1
Subject 1: Professions in Science and Technology 1
VHS: 10:30 p.m. (Class: 1:30 a.m.)
Credits: 1
Coefficient: 1

Objective of the subject:
Introduce the student, in a first step, to all the courses that are covered by the Domain of Science and Technology and in a second step, a panoply of professions to which these courses lead. In the same context, this subject introduces the new challenges of sustainable development as well as the new professions that may arise from it.

Prior knowledge recommended
None.

Material content:
1. What are engineering sciences? (2 weeks)
The engineering profession, history and challenges of the 21st century, Search for a profession/recruitment advertisement by keyword, draw up a simple job description (job title, company, main activities, skills required (knowledge, know-how , relational

2. Electronics, Telecommunications, Biomedical Engineering, Electrotechnics, Electromechanics, Optics & Precision Mechanics: (2 weeks)
- Definitions, fields of application (Home automation, on-board automotive applications, Video surveillance, Mobile telephony, Fiber optics, State-of-the-art scientific instrumentation, Medical imaging and instrumentation, Giant mirrors, Contact lenses, Electric power transmission and distribution , Electricity production plants, Energy efficiency, Maintenance of industrial equipment, Elevators, Wind turbines, …
- Role of the specialist in these fields.

3. Automation and Industrial Engineering streams: (1 week)
- Definitions, fields of application (automated industrial chains, CNC machine tools, robotics, inventory management, goods traffic management, quality, - Role of the specialist in these fields.

4. Process Engineering, Hydrocarbons and Petrochemical Industries sectors: (2 weeks)
- Definitions, Pharmaceutical industry, Food industry, Leather and textile industry, Biotechnology, Chemical and petrochemical industry, Plastics, Energy sector (oil, gas), etc.
- Role of the specialist in these fields.

5. Sustainable development (SD): (4 weeks)
Definitions, Planetary issues (climate change, Demographic transitions, Depletion of resources (oil, gas, coal, etc.), Impoverishment of biodiversity, etc.), SD diagram (Sustainable = Viable + Livable + Equitable), SD actors (governments , citizens, socio-economic sector, international organizations, etc.), Global nature of SD challenges

6. Sustainable engineering: (4 weeks)
Definition, Principles of sustainable engineering (definitions of: sustainable energy/energy efficiency, sustainable mobility/ecomobility, valorization of resources (water, metals and minerals, etc.), sustainable production), Relevance of sustainable engineering in S&T sectors , Relationship

between sustainability and engineering, Responsibility of engineers in carrying out sustainable projects, …

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

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

Assessment method:
100% review

Bibliographic 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 de l'environnement et du développement durable, Collection : Parcours, Edition : ONISEP, 2015.
8- Les métiers du bâtiment et des travaux publics, Collection : Parcours, Edition : ONISEP, 2016.
9- Les métiers du transport et de la logistique, Collection : Parcours, Edition : ONISEP, 2016.
10- Les métiers de l'énergie, Collection : Parcours, Edition : ONISEP, 2016.
11- Les métiers de la mécanique, Collection : Parcours, Edition : ONISEP, 2014.
12- Les métiers de la chimie, Collection : Parcours, Edition : ONISEP, 2017.
13- Les métiers du Web, Collection : Parcours, Edition : ONISEP, 2015.
14- Les métiers de la biologie, Collection : Parcours, Edition : ONISEP, 2016.

Semester: 1
Course unit: UET 3.1
Subject: Ethical and deontological dimension (the foundations)
VHS: 10:30 p.m. (Class: 1:30 a.m.)
Credits: 1
Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge:
None

Material content:

I. Fundamentals – (2 weeks)
Definitions:
1. Morality:
2. Ethics:
3. Deontology "Theory of Duty":
4. The law:
5. Distinction between the different notions
A. Distinction between Ethics and Morality
B. Distinction between ethics and deontology
II. References (2 weeks)
The philosophical references
The religious reference
The evolution of civilizations
The institutional reference
III. The University Franchise (3 weeks)
The Concept of University Franchises
Regulatory texts
Royalties from university franchises
University campus actors
IV. University Values – (2 weeks)
Social Values
Community Values
Professional Values
V. Rights and Duties (2 weeks)
Student Rights
Student's homework
Teachers' rights
Obligations of the professor-researcher
Obligations of administrative and technical staff

VI. University Relations (2 weeks)
Definition of the concept of academic relations
Student-teacher relations
Student-student relationship
Student - Staff Relations
Student relationship – Association members
VII. Practices (2 weeks)
Good practices For the teacher
Good practices For the student

Bibliographic references

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

Semester: 1
Course unit: UET 1.1
Subject 1: French language1
VHS: 10:30 p.m. (Class: 1:30 a.m.)
Credits: 1
Coefficient: 1

Teaching objectives:
It is a question of developing in this subject the following four skills: Oral comprehension, Written comprehension and Oral expression, Written expression through reading and the study of texts.

Recommended prior knowledge:
Basic French.

Material content:
We propose below a set of themes that deal with basic sciences, technologies, economy, social facts, communication, sport, health, etc. The teacher can choose from this list of texts to develop them during the course. Otherwise, he is free to address other topics of his choice. The texts can be borrowed from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular magazines, books, websites, audio and video recordings, etc.
For each text, the teacher helps the student to develop their language skills: listening, comprehension, both oral and written expression. In addition, they must use this text to identify the grammatical structures that they will develop during the same course session. We recall here, by way of illustration, a set of grammatical structures that can be developed as an example. Of course, it is not a question of developing them all or in the same way. Some can be recalled and others well detailed.

Examples of themes	Grammatical structures
Climate change Pollution The electric car The robots artificial intelligence Nobel prize Olympic Games sports at school The Sahara The currency The line work ecology Nanotechnology The optical fiber The profession of engineer The power station Energetic efficiency The smart building Wind energy Solar energy	The punctuation. proper nouns, articles. Grammatical functions: noun, verb, pronouns, adjective, adverb. The complement pronoun “the, the, the, him, their, y, en, me, you, …” Agreements. The negative sentence. Don't, Don't... yet, Don't... anymore, Don't... never, Don't... The interrogative sentence. Question with "Who, What, What", Question with "When, Where, How Much, Why, How, Which, Which". The exclamatory sentence. Reflexive verbs. impersonal verbs. The tenses of the indicative, Present, Future, past tense, past simple, Imperfect. …

Assessment method:

Review: 100%.

Bibliographic references:

1. M. Badefort, Objectif : Test de Français International, Edulang, 2006.
2. O. Bertrand, I. Schaffner, Réussir le TCF, Exercices et activités d'entrainement, Les éditions de l'école polytechnique, 2009.
3. M. Boulares, J.-L. Frerot, Grammaire progressive du Français avec 400 exercices, Niveau avancé, CLE International.
4. Collectif, Besherelles : la Grammaire pour tous, Hatier.
5. Collectif, Besherelles : la Conjugaison pour tous, Hatier.
6. M. Grégoire, Grammaire progressive du Français avec 400 exercices, Niveau débutant, CLE International, 1997.
7. A. Hasni et al., La formation à l'enseignement des sciences et des technologies au secondaire, Presses de l'université du Québec, 2006.
8. J.-L. Lebrun, Guide pratique de la rédaction scientifique, EDP Sciences, 2007.
9. J.M. Robert, Difficultés du Français, Hachette,
10. C. Tisset, Enseigner la langue française à l'école : La Grammaire, L'Orthographe et la Conjugaison, Hachette Education, 2005.
11. J. Bossé-Andrieu, Abrégé des Règles de Grammaire et d'Orthographe, Presses de l'université du Québec, 2001.
12. J.-P. Colin, Le français tout simplement, Eyrolles, 2010.
13. Collectif, Test d'évaluation de Français, Hachette, 2001.
14. Y. Delatour et al., Grammaire pratique du Français en 80 fiches avec exercices corrigées, Hachette, 2000.
15. Ch. Descotes et al., L'Exercisier : l'expression française pour le niveau intermédiaire, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, Sur le Vif, Heinle Cengage Learning, 2011.
17. J. Dubois et al., Les indispensables – Orthographe, Larousse, 2009.

Semester: 1
Course unit: UET 1.1
Subject 1: English Language1
VHS: 10:30 p.m. (Class: 1:30 a.m.)
Credit: 1
Coefficient: 1

Objective:
Develop the reading, writing, listening and speaking abilities of the students.

Recommended prior Knowledge:
Basic English.

Contents:
The English syllabus consists of a set of texts containing scientific and technical parts. The chosen texts must be used to study scientific and technical English and Grammar acquisition.
The texts must be selected according to the vocabulary built up, familiarization with both scientific and technical matters in English for further understanding. Therefore, each text will be defined by a set of vocabulary concepts, a set of special sentences (idioms) and comprehension questions.
The texts must contain also a terminology which means the translation of some words from English to French one. Besides, the activity at the end of each session must include a translation of long statements which are selected from the texts.

Examples for some lectures:	Examples of Word Study: Patterns
Iron and Steel	Make + Noun + Adjective
Heat Treatment of Steel.	Quantity, Contents
Lubrification of Bearings.	Enable, Allow, Make, etc. + Infinitive
The Lathe.	Comparative, Maximum and Minimum
Welding.	The Use of Will, Can and May
Steam Boilers.	Prevention, Protection, etc., Classification
Steam Locomotives.	The Impersonal Passive
Condensation and Condensers.	Passive Verb + By + Noun (agent)
Centrifugal Governors.	Too Much or Too Little
Impulse Turbines.	Instructions (Imperative)
The Petro Engine.	Requirements and Necessity
The Carburation System.	Means (by + Noun or –ing)
The Jet Engine.	Time Statements
The Turbo-Prop Engine.	Function, Duty
Aerofoil.	Alternatives

Evaluation mode:
Exam : 100%.

References:

1. J. Upjohn, S. Blattes, V. Jans, Minimum Competence in Scientific English, Office des Publications Universitaires, 1994.
2. A.J. Herbert, The Structure of Technical English, Longman, 1972.
3. S. Berland-Delepine, Grammaire méthodique de l'anglais moderne avec exercices, Ophrys, 1982.
4. Test of English as a Foreign Language – Preparation Guide, Cliffs, 1991.
5. R. Fowler, The Little, Brown Handbook, Little, Brown Company, 1980.
6. Cambridge – First Certificate in English, Cambridge books, 2008.
7. K. Wilson, Th. Healy, First Choice, Oxford, 2007.
8. M. Mann, S. Tayore-Knowles, Destination : Grammar & Vocabulary with Answer Key, MacMillan, 2006.
9. E. Hamby, Ph. Bedford Robinson, Special English Computer Applications, Cassell, 1980.
10. P. Charles Brown, Norma D. Mullen, English for Computer Science, Oxford University Press, 1989.

11. Graeme Kennedy, Structure and Meaning in English: A Guide for Teachers, Pearson, 2004.
12. Anne M. Hanson, Brain-Friendly Strategies for Developing Student Writing Skills, 2nd Edition, Corwin Press, 2008.
13. Ann Bridges, How to Pass Higher English, Hodder Gibson-Hachette, 2009.
14. Claude Renucci, Anglais : 1000 Mots et expressions de la presse : Vocabulaire et expressions du monde économique, social et politique, Fernand Nathan, 2006.

Semester: 2
Teaching unit: UEF 1.2
Subject 1: Mathematics 2
VHS: 67h30 (Lectures: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

Students are gradually introduced to mathematics that are useful for their university curriculum. At the end of the course, the student should be able to: solve first and second-degree differential equations; solve integrals of rational, exponential, trigonometric, and polynomial functions; solve systems of linear equations by several methods.

Recommended prerequisite knowledge:

Basic knowledge of mathematics (differential equation, integrals, systems of equations, ...).

Course content:

Chapter 1: Matrices and determinants (3 weeks)

1-1 Matrices (Definition, operation). 1-2 Matrix associated with a linear application. 1-3 Linear application associated with a matrix. 1-4 Change of basis, passage matrix.

Chapter 2: Linear systems of equations (2 weeks)

2-1 Generalities. 2-2 Study of the set of solutions. 2-3 Methods of solving a linear system. Solution by Cramer's method. Solution by the inverse matrix method. Solution by the Gauss method.

Chapter 3: Integrals (4 weeks)

3-1 Indefinite integral, property. 3-2 Integration of rational functions. 3-3 Integration of exponential and trigonometric functions. 3-4 Integral of polynomials. 3-5 Definite integration.

Chapter 4: Differential equations (4 weeks)

4-1 Ordinary differential equations. 4-2 First-order differential equations. 4-3 Second-order differential equations. 4-4 Ordinary differential equations of the second order with constant coefficient.

Chapter 5: Functions of several variables (2 weeks)

5-1 Limit, continuity, and partial derivatives of a function. 5-2 Differentiability. 5-3 Double, triple integrals.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1- F. Ayres Jr, Théorie et Applications du Calcul Différentiel et Intégral - 1175 exercices corrigés, McGraw-Hill.

2- F. Ayres Jr, Théorie et Applications des équations différentielles - 560 exercices corrigés, McGraw-Hill.

3- J. Lelong-Ferrand, J.M. Arnaudiès, Cours de Mathématiques - Equations différentielles, Intégrales multiples, Tome 4, Dunod Université.

4- M. Krasnov, Recueil de problèmes sur les équations différentielles ordinaires, Edition de Moscou

5- N. Piskounov, Calcul différentiel et intégral, Tome 1, Edition de Moscou

6- J. Quinet, Cours élémentaire de mathématiques supérieures 3- Calcul intégral et séries, Dunod.

7- J. Quinet, Cours élémentaire de mathématiques supérieures 4- Equations différentielles, Dunod.

8- J. Quinet, Cours élémentaire de mathématiques supérieures 2- Fonctions usuelles, Dunod.

9- J. Quinet, Cours élémentaire de mathématiques supérieures 1- Algèbre, Dunod.

10- J. Rivaud, Algèbre : Classes préparatoires et Université Tome 1, Exercices avec solutions, Vuibert.

11- N. Faddeev, I. Sominski, Recueil d'exercices d'algèbre supérieure, Edition de Moscou.

Semester: 2
Teaching Unit: UEF 1.2
Subject 2: Physics 2
VHS: 67h30 (Lectures: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:
To introduce the student to the physical phenomena underlying the laws of electricity in general.

Recommended prerequisites:
Mathematics 1, Physics 1.

Subject contents:
Mathematical review: (1 week)
1- Elements of length, surface, and volume in Cartesian, cylindrical, and spherical coordinate systems. Solid angle, Operators (gradient, curl, Nabla, Laplacian, and divergence).
2- Multiple derivatives and integrals.

Chapter I. Electrostatics: (6 weeks)
1- Electric charges and fields. Electrostatic interaction force-Coulomb's law.
2- Electrostatic potential. 3- Electric dipole. 4- Flux of the electric field. 5- Gauss's theorem. 6- Conductors in equilibrium. 7- Electrostatic pressure. 8- Capacitance of a conductor and a capacitor.

Chapter II. Electrodynamics: (4 weeks)
1- Electric conductor. 2- Ohm's law. 3- Joule's law. 4- Electric circuits. 5- Application of Ohm's law to networks. 6- Kirchhoff's laws. Thevenin's theorem.

Chapter III. Electromagnetism: (4 weeks)
1- Magnetic field: Definition of a magnetic field, Biot-Savart law, Ampere's theorem, Calculation of magnetic fields created by permanent currents.
2- Induction phenomena: Induction phenomena (circuit in a variable magnetic field and a moving circuit in a permanent magnetic field), Lorentz force, Laplace force, Faraday's law, Lenz's law, Application to coupled circuits.

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

Bibliographic references:

1. J.-P. Perez, R. Carles, R. Fleckinger ; Electromagnétisme Fondements et Applications, Ed. Dunod, 2011.
2. H. Djelouah ; Electromagnétisme ; Office des Publications Universitaires, 2011.
3. P. Fishbane et al. ; Physics For Scientists and Engineers with Modern Physics, 3rd ed. ; 2005.
4. P. A. Tipler, G. Mosca ; Physics For Scientists and Engineers, 6th ed., W. H. Freeman Company, 2008.

Semester: 2
Teaching Unit: UEF 1.2
Subject 3: Thermodynamics
VHS: 67h30 (Lectures: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives
To provide the necessary foundations of classical thermodynamics for applications in combustion and thermal machines. To homogenize the students' knowledge. The skills to be acquired are: The acquisition of a scientific basis of classical thermodynamics; The application of thermodynamics to various systems; The statement, explanation, and understanding of the fundamental principles of thermodynamics.

Recommended prerequisites
Basic knowledge of mathematics and general chemistry.

Course Content:
Chapter 1: Generalities on Thermodynamics (3 weeks)
1- Fundamental properties of state functions. 2- Definition of thermodynamic systems and the external environment. 3- Description of a thermodynamic system. 4- Evolution and thermodynamic equilibrium states of a system. 5- Possible transfers between the system and the external environment. 6- Transformations of the state of a system (operation, evolution). 7- Review of the ideal gas laws.

Chapter 2: The First Law of Thermodynamics: (3 weeks)

Work, heat, internal energy, concept of energy conservation. 2. The First Law of Thermodynamics: statement, concept of internal energy of a system, application to ideal gas, enthalpy function, heat capacity, reversible transformations (isochoric, isobaric, isothermal, adiabatic).
Chapter 3: Applications of the First Law of Thermodynamics to Thermochemistry (3 weeks)
Reaction heats, standard state, standard enthalpy of formation, dissociation enthalpy, enthalpy of physical state change, enthalpy of a chemical reaction, Hess's law, Kirchhoff's law.

Chapter 4: The Second Law of Thermodynamics (3 weeks)
1- The Second Law for a closed system. 2. Statement of the Second Law: Entropy of an isolated closed system. 3. Calculation of entropy variation: reversible isothermal transformation, reversible isochoric transformation, reversible isobaric transformation, adiabatic transformation, during a change of state, during a chemical reaction.

Chapter 5: The Third Law and Absolute Entropy (1 week)

Chapter 6: Free Energy and Enthalpy - Criteria for the Evolution of a System (2 weeks)
1- Introduction. 2- Free energy and enthalpy. 3- Chemical equilibria.

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

References:

1. C. Coulon, S. Le Boiteux S. et P. Segonds, Thermodynamique Physique - Cours et exercices avec solutions, Edition Dunod.

2. H.B. Callen, Thermodynamics, Cours, Edition John Wiley and Sons, 1960

3. R. Clerac, C. Coulon, P. Goyer, S. Le Boiteux & C. Rivenc, Thermodynamics, Cours et travaux dirigés de thermodynamique, Université Bordeaux 1, 2003

4. O. Perrot, Cours de Thermodynamique I.U.T. de Saint-Omer Dunkerque, 2011

5. C. L. Huillier, J. Rous, Introduction à la thermodynamique, Edition Dunod.

Semester: 2
Teaching Unit: UEM 1.2
Subject 1: Physics 2 Lab
Lecture Hours per Week: 45h00 (Lab: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:
To reinforce, through practical work sessions, the theoretical concepts covered in the Physics 2 course.

Recommended Prerequisite Knowledge:
Mathematics 1, Physics 1.

Subject Content:

Minimum of 5 experiments (3h00 / 15 days)

Presentation of measuring instruments and tools (voltmeter, ammeter, rheostat, oscilloscopes, generator, etc.).
Kirchhoff's laws (mesh law, nodal law).
Thevenin's theorem.
Association and measurement of inductance and capacitance
Charging and discharging of a capacitor
Oscilloscope
Lab work on magnetism
Assessment Method:
Continuous assessment: 100%

Semester: 2
Teaching Unit: UEM 1.2
Subject 2: Chemistry Lab 2
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives
To consolidate the theoretical concepts covered in the Thermodynamics course through practical lab sessions.

Recommended Prerequisites
Thermodynamics.

Course Content:

Ideal gas laws.
Water equivalent of a calorimeter.
Specific heat: specific heat of liquids and solids.
Latent heat: latent heat of fusion of ice.
Reaction heat: Determination of the energy released by a chemical reaction (HCl/NaOH).
Hess's law.
Vapor pressure of a solution.
Assessment Method:
Continuous assessment: 100%

Semester: 2
Teaching Unit: UEM 1.2
Subject 3: Computer Science 2
VHS: 45h00 (Lecture: 1h30, Lab: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives
To master the basic techniques in programming and algorithms, and to acquire the fundamental concepts of computer science. The skills to be acquired are: programming with some autonomy; designing algorithms from simple to relatively complex.

Recommended Prerequisites
Knowing how to use the university website, file systems, Windows user interface, and programming environment.

Course Content:
Chapter 1: Indexed Variables (4 Weeks)

One-dimensional arrays: Representation in memory, Operations on arrays.
Two-dimensional arrays: Representation in memory, Operations on two-dimensional arrays.
Chapter 2: Functions and Procedures (6 Weeks)

Functions: Types of functions, Function declaration, Function call.
Procedures: Concepts of global and local variables, Simple procedure, Procedure with arguments.
Chapter 3: Records and Files (5 Weeks)

Heterogeneous data structures.
Structure of a record (field concept).
Manipulation of record structures.
Concept of a file.
File access modes.
Reading and writing to a file.
Computer Science Lab 2:
A number of labs will be scheduled to practice the programming techniques learned during the course.

Lab applying programming techniques learned in class.
Assessment Method:
Continuous assessment: 40%; Exam: 60%.

Bibliographical References:"
1- Les algorithmes pour les Nuls grand format Livre de John Paul Mueller (Informatiker, USA) et Luca Massaron 2017

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

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

Semester: 2
Teaching unit: UEM 1.2
Subject 4: Presentation Methodology
VHS: 15h00 (Class: 1h00)
Credits: 1
Coefficient: 1

Teaching objectives:
To provide the main foundations for succeeding in an oral presentation. Among the skills to be acquired: knowing how to prepare a presentation; knowing how to deliver a presentation; knowing how to capture the audience's attention; being aware of the pitfalls of plagiarism and understanding the regulations of intellectual property.

Recommended prior knowledge:
Techniques of expression and communication, and methodology of writing.

Subject matter:

Chapter 1: The oral presentation (3 weeks)
Communication. Preparation of an oral presentation. Different types of outlines.

Chapter 2: Delivering an oral presentation (3 weeks)
Structure of an oral presentation. Delivering an oral presentation.

Chapter 3: Plagiarism and intellectual property (3 weeks)
1- Plagiarism: Definitions of plagiarism, sanctions for plagiarism, how to borrow from the work of other authors, quotations, illustrations, how to ensure that you avoid plagiarism.
2- Writing a bibliography: Definition, objectives, how to present a bibliography, writing a bibliography.

Chapter 4: Presenting a written work (6 weeks)
Presenting a written work. Applications: delivering an oral presentation.

Evaluation method:
Exam: 100%.

Bibliographic references:
1. M. Fayet, Méthodes de communication écrite et orale, 3e édition, Dunod, 2008.

2. M. Kalika, Mémoire de master – Piloter un mémoire, Rédiger un rapport, Préparer une soutenance, Dunod, 2016.

3. M. Greuter, Réussir son mémoire et son rapport de stage, l'Etudiant, 2014

4. B. Grange, Réussir une présentation. Préparer des slides percutants et bien communiquer en public. Eyrolles, 2009.

5. H. Biju-Duval, C. Delhay, Tous orateurs, Eyrolles, 2011.

6. C. Eberhardt, Travaux pratiques avec PowerPoint. Créer et mettre en page des diapositives, Dunod, 2014.

7. F. Cartier, Communication écrite et orale, Edition GEP- Groupe Eyrolles, 2012.

8. L. Levasseur, 50 exercices pour prendre la parole en public, Eyrolles, 2009.

9. S. Goodlad, Speaking technically – A Handbook for Scientists, Engineers, and Physicians on How to Improve Technical Presentations, Imperial College Press, 2000.

10. M. Markel, Technical communication, eleventh edition, Bedford/St Martin's, 2015.

Semester: 2
Teaching Unit: UED 1.2
Subject 1: Careers in Science and Technology 2
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Objectives:
The subject aims to introduce students to the range of fields covered by the science and technology domain and the variety of careers that stem from those fields. In addition, it aims to introduce students to new challenges in sustainable development and the emerging careers that may result from these challenges.

Recommended prerequisite knowledge:
None.

Course content:

1. **Industrial Hygiene and Safety (IHS) and Mining Engineering: (2 weeks)**

Definitions and application areas (safety of people and property, environmental issues, exploration and exploitation of mineral resources, etc.)
Role of specialists in these areas.

2. **HVAC Engineering and Transportation Engineering: (2 weeks)**

Definitions and application areas (air conditioning, smart buildings, transportation safety, traffic management and road, air, and naval transportation, etc.)
Role of specialists in these areas.

3. **Civil Engineering, Hydraulic Engineering, and Public Works: (2 weeks)**

Definitions and application areas (construction materials, large road and rail infrastructures, bridges, airports, dams, drinking water supply and sanitation, hydraulic flow, water resource management, public works and land use planning, smart cities, etc.)
Role of specialists in these areas.

4. **Aeronautical Engineering, Mechanical Engineering, Maritime Engineering, and Metallurgy: (2 weeks)**

Definitions and application areas (aeronautics, avionics, automotive industry, ports, dikes, production of industrial equipment, steelmaking, metal transformation, etc.)
Role of specialists in these areas.

5. **Sustainable Production Approaches: (2 weeks)**

Industrial Ecology, Remanufacturing, Eco-design.

6. **Measuring the Sustainability of a Process/Product/Service: (2 weeks)**

Environmental Analysis, Life Cycle Assessment (LCA), Carbon Footprint, Case Studies/Applications.

7. **Sustainable Development and Enterprise: (3 weeks)**

Definition of the company as an economic entity (notions of profit, costs, performance) and a social entity (notion of corporate social/societal responsibility), Impact of economic activities on the environment (examples), Challenges/benefits of SD for the company, Ways of engagement in an SD approach (e.g., ISO 14001 certification, labeling (e.g., energy labeling, Ecolabel, Bio/AB label, FSC label, etc.), SD strategic plan, Global Reporting Initiative (GRI)...), World rankings of the most sustainable companies (Dow Jones Sustainable Index, Global 100, etc.), Case studies of high-performing/eco-responsible companies in the ST sector (e.g., SIEMENS, Cisco, Henkel AG & Co, TOTAL, Peugeot, Eni SPA...).

Student work for this subject:

Work in groups/pairs: Reading articles on sustainable development and/or reports of high-performing and sustainable companies and summarizing the main actions taken in the field of SD.
Examples of documents for reading and synthesis:
ONA and ENIEM case: Kadri, Mouloud, 2009, Sustainable Development, Enterprise, and ISO 14001 Certification, Market and Organizations Vol. 1 (N° 8), p. 201-215 (freely accessible online: http://www.cairn.info/revue-marche-et-organisations-2009-1-page-201.htm)
Mireille Chiroleu-Assouline. The Sustainable Development Strategies of Companies. Ideas, The Review of Economic and Social Sciences, CNDP, 2006, p 32"Free online access: http://halshs.archives-ouvertes.fr/hal-00306217/document

Web page on TOTAL's environmental and societal commitments: https://www.total.com/en/commitments
Sustainable mobility innovations of PSA Group: http://www.rapportannuel.groupe-psa.com/rapport-2015/engagements/dessolutions-innovantes-pour-des-transports-durables/

Evaluation method:
100% exam

Bibliographical references:
1- V. Maymo et G. Murat, La boîte à outils du Développement durable et de la RSE- 53 outils et méthodes, Edition : Dunod, 2017.

2- P. Jacquemot et V. Bedin, Le dictionnaire encyclopédique du développement durable, Edition : Sciences Humaines, 2017.

3- Y. Veyret, J. Jalta et M. Hagnerelle, Développements durables : Tous les enjeux en 12 leçons, Edition : Autrement, 2010.

4- L. Grisel et Ph. Osset, L'Analyse du cycle de vie d'un produit ou d'un service: Applications et mise en pratique, 2eme Edition : AFNOR, 2008.

5- Sh. Shaked, N. Jolliet-Gavin, P. Crettaz, M. Saadé-Sbeih et O. Jolliet, Analyse du cycle de vie: Comprendre et réaliser un écobilan, 3eme Edition : PPUR, 2017.

6- G. Pitron et H. Védrine, La guerre des métaux rares : La face cachée de la transition énergétique et numérique, Edition : Liens qui libèrent, 2018.

7- Les métiers de l'environnement et du développement durable, Collection : Parcours, Edition : ONISEP, 2015.

Semester: 2
Teaching Unit: UET 1.2
Subject 1: French Language 2
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
The aim of this subject is to develop the following four competencies: oral comprehension, written comprehension, oral expression, and written expression through the reading and study of texts.

Recommended prior knowledge:
Basic French.

Subject content:
We propose below a set of themes that cover fundamental sciences, technology, economics, social facts, communication, sports, health, etc. The teacher can choose texts from this list to develop during the course. Otherwise, he or she is free to address other themes of his or her choice. The texts can be taken from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular science journals, books, websites, audio and video recordings, etc.
For each text, the teacher helps the student develop his or her language competencies: listening, comprehension, and both oral and written expression. In addition, he or she must use the text to identify the grammatical structures that will be developed during the same class session. We remind here, by way of illustration, a set of grammatical structures that can be developed as examples. Of course, it is not a matter of developing them all or in the same way. Some may be recalled and others well detailed.

Examples of themes	**Grammatical structures**
The pharmaceutical industry The agri-food industry The National Employment Agency ANEM Sustainable development Renewable energy Biotechnology Stem cells Road safety Dams Water - Water resources Avionics Automotive electronics Electronic newspapers Carbon-14 dating Violence in stadiums Drug addiction: a social scourge Smoking School failure The Algerian War Social networks China, an economic power Superconductivity Cryptocurrency	The subjunctive. The conditional. The imperative. The past participle. The passive form. Possessive adjectives. Possessive pronouns. Demonstratives. Demonstrative pronouns. Expressions of quantity (several, some, enough, many, more, less, as much, etc.). Numbers and measurements. Relative pronouns 'who, whom, where, whose'. Subordinate prepositions of time. Cause and effect. Purpose, opposition, condition. Comparatives, superlatives. ...

Advertising Autism"	

Mode of assessment:
Exam: 100%.

Bibliographic references:

1. M. Badefort, Objectif : Test de Français International, Edulang, 2006.
2. O. Bertrand, I. Schaffner, Réussir le TCF, Exercices et activités d'entrainement, Les éditions de l'école polytechnique, 2009.
3. M. Boulares, J.-L. Frerot, Grammaire progressive du Français avec 400 exercices, Niveau avancé, CLE International.
4. Collectif, Besherelles : la Grammaire pour tous, Hatier.
5. Collectif, Besherelles : la Conjugaison pour tous, Hatier.
6. M. Grégoire, Grammaire progressive du Français avec 400 exercices, Niveau débutant, CLE International, 1997.
7. A. Hasni et al., La formation à l'enseignement des sciences et des technologies au secondaire, Presses de l'université du Québec, 2006.
8. J.-L. Lebrun, Guide pratique de la rédaction scientifique, EDP Sciences, 2007.
9. J.M. Robert, Difficultés du Français, Hachette,
10. C. Tisset, Enseigner la langue française à l'école : La Grammaire, L'Orthographe et la Conjugaison, Hachette Education, 2005.
11. J. Bossé-Andrieu, Abrégé des Règles de Grammaire et d'Orthographe, Presses de l'université du Québec, 2001.
12. J.-P. Colin, Le français tout simplement, Eyrolles, 2010.
13. Collectif, Test d'évaluation de Français, Hachette, 2001.
14. Y. Delatour et al., Grammaire pratique du Français en 80 fiches avec exercices corrigees, Hachette, 2000.
15. Ch. Descotes et al., L'Exercisier : l'expression française pour le niveau intermédiaire, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, Sur le Vif, Heinle Cengage Learning, 2011.
17. J. Dubois et al., Les indispensables – Orthographe, Larousse, 2009.

Semester: 2
Teaching Unit: UET 1.2
Subject 1: English Language 2
VHS: 22h30 (Class: 1h30)
Credits: 1
Coefficient: 1"

Objective:
Develop the reading, writing, listening and speaking abilities of the students.

Recommended prior Knowledge:
Basic English.

Contents:
The English syllabus consists of a set of texts containing scientific and technical parts. The chosen texts must be used to study scientific and technical English and Grammar acquisition.
The texts must be selected according to the vocabulary built up, familiarization with both scientific and technical matters in English for further understanding. Therefore, each text will be defined by a set of vocabulary concepts, a set of special sentences (idioms) and comprehension questions.
The texts must contain also a terminology which means the translation of some words from English to French one. Besides, the activity at the end of each session must include a translation of long statements which are selected from the texts.

Examples for some lectures:	Examples of Word Study: Patterns
Radioactivity.	Explanation of Cause
Chain Reaction.	Result
Reactor Cooling System.	Conditions (if), Conditions (Restrictive)
Conductor and Conductivity.	Eventuality
Induction Motors.	Manner
Electrolysis.	When, Once, If, etc. + Past Participle
Liquid Flow and Metering.	It is + Adjective + to
Liquid Pumps.	As
Petroleum.	It is + Adjective or Verb + that…
Road Foundations.	Similarity, Difference
Rigid Pavements.	In Spite of, Although
Piles for Foundations.	Formation of Adjectives
Suspension Bridges.	Phrasal Verbs

Evaluation mode:
Exam : 100%.

References:

1. J. Upjohn, S. Blattes, V. Jans, Minimum Competence in Scientific English, Office des Publications Universitaires, 1994.
2. A.J. Herbert, The Structure of Technical English, Longman, 1972.
3. S. Berland-Delepine, Grammaire méthodique de l'anglais moderne avec exercices, Ophrys, 1982.
4. Test of English as a Foreign Language – Preparation Guide, Cliffs, 1991.
5. R. Fowler, The Little, Brown Handbook, Little, Brown Company, 1980.
6. Cambridge – First Certificate in English, Cambridge books, 2008.
7. K. Wilson, Th. Healy, First Choice, Oxford, 2007.
8. M. Mann, S. Tayore-Knowles, Destination : Grammar & Vocabulary with Answer Key, MacMillan, 2006.
9. E. Hamby, Ph. Bedford Robinson, Special English Computer Applications, Cassell, 1980.
10. P. Charles Brown, Norma D. Mullen, English for Computer Science, Oxford University Press, 1989.
11. Graeme Kennedy, Structure and Meaning in English: A Guide for Teachers, Pearson, 2004.

12. Anne M. Hanson, Brain-Friendly Strategies for Developing Student Writing Skills, 2nd Edition, Corwin Press, 2008.
13. Ann Bridges, How to Pass Higher English, Hodder Gibson-Hachette, 2009.
Claude Renucci, Anglais : 1000 Mots et expressions de la presse : Vocabulaire et expressions du monde économique, social et politique, Fernand Nathan, 2006.

Semester: 3
Teaching Unit: UEF 2.1.1
Subject 1: Mathematics 3
VHS: 67h30 (Lectures: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives:
By the end of this course, the student should be able to understand the different types of series and their convergence conditions as well as the different types of convergence.

Recommended Prerequisites:
Mathematics 1 and Mathematics 2

Subject Content:
Chapter 1: Simple and Multiple Integrals 3 weeks
1.1 Review of Riemann integral and computation of primitives. 1.2 Double and triple integrals.
1.3 Applications to area and volume computations, etc.

Chapter 2: Improper Integrals 2 weeks
2.1 Integrals of functions defined on an unbounded interval. 2.2 Integrals of functions defined on a bounded interval, infinite at one endpoint.

Chapter 3: Differential Equations 2 weeks
3.1 Review of ordinary differential equations. 3.2 Partial differential equations. 3.3 Special functions.

Chapter 4: Series 3 weeks
4.1 Numerical series. 4.2 Sequences and series of functions. 4.3 Power series, Fourier series.

Chapter 5: Fourier Transformation 3 weeks
5.1 Definition and properties. 5.2 Application to differential equation solving.

Chapter 6: Laplace Transformation 2 weeks
6.1 Definition and properties. 6.2 Application to differential equation solving.

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

Bibliographic References:
1- F. Ayres Jr, Théorie et Applications du Calcul Différentiel et Intégral - 1175 exercices corrigés, McGraw-Hill.

2- F. Ayres Jr, Théorie et Applications des équations différentielles - 560 exercices corrigés, McGraw-Hill.

3- J. Lelong-Ferrand, J.M. Arnaudiès, Cours de Mathématiques - Equations différentielles, Intégrales multiples, Tome 4, Dunod Université.

4- M. Krasnov, Recueil de problèmes sur les équations différentielles ordinaires, Edition de Moscou

5- N. Piskounov, Calcul différentiel et intégral, Tome 1, Edition de Moscou

6- J. Quinet, Cours élémentaire de mathématiques supérieures 3- Calcul intégral et séries, Dunod.

7- J. Quinet, Cours élémentaire de mathématiques supérieures 4- Equations différentielles, Dunod.

8- M. R. Spiegel, Transformées de Laplace, Cours et problèmes, 450 Exercices corrigés, McGraw-Hill.

Semester: 3
Teaching unit: UEF 2.1.1
Subject 2: Waves and Vibrations
Contact hours: 45 hours (Lectures: 1h30, Tutorials: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
To introduce students to mechanical vibration phenomena limited to low-amplitude oscillations for 1 or 2 degrees of freedom as well as to the study of the propagation of mechanical waves.

Recommended prerequisite knowledge:
Mathematics 2, Physics 1, and Physics 2

Subject content:
Introduction: This subject is divided into two parts, Waves and Vibrations, which can be approached independently of each other. With regard to the consistency of the subject matter, it is advisable to approach this subject in the following order: Waves and then Vibrations for students in the Electrical Engineering field (Group A). For students in Groups B and C (Civil Engineering, Mechanical Engineering, and Process Engineering), it is wise to start with Vibrations. In any case, the teacher is called upon to do his or her best to cover both parts. We remind you that this subject is intended for engineering professions in the field of Science and Technology. Therefore, the teacher is requested to skim over all parts of the course that require demonstrations or theoretical developments and to focus only on the practical aspects. Demonstrations can be used as auxiliary work to be assigned to students as activities as part of their personal work. Please refer to the paragraph "G- Student evaluation through continuous assessment and personal work" in this course offering for more information.

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

Chapter 2: Free oscillations of single-degree-of-freedom systems 2 weeks
2.1 Undamped oscillations
2.2 Free oscillations of damped systems

Chapter 3: Forced oscillations of single-degree-of-freedom systems 1 week
3.1 Differential equation
3.2 Mass-spring-damper system
3.3 Solution of the differential equation
3.3.1 Harmonic excitation
3.3.2 Periodic excitation
3.4 Mechanical impedance

Chapter 4: Free oscillations of two-degree-of-freedom systems 1 week

4.1 Introduction
4.2 Systems with two degrees of freedom

Chapter 5: Forced oscillations of two-degree-of-freedom systems 2 weeks
5.1 Lagrange's equations
5.2 Mass-spring-damper systems
5.3 Impedance
5.4 Applications
5.5 Generalization to n-degree-of-freedom systems

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

Chapter 2: Vibrating strings 2 weeks
2.1 Wave equation
2.2 Harmonic progressive waves
2.3 Free oscillations of a finite length string
2.4 Reflection and transmission

Chapter 3: Acoustic Waves in Fluids
3.1 Wave Equation
3.2 Speed of Sound
3.3 Sinusoidal Progressive Wave
3.4 Reflection-Transmission

Chapter 4: Electromagnetic Waves
4.1 Wave Equation
4.2 Reflection-Transmission
4.3 Different Types of Electromagnetic Waves

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

Bibliography:

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
Subject 1: Fundamental Electronics 1
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

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

Recommended prerequisites:
Basic knowledge of material physics and fundamental electricity.

Subject content:
The number of weeks displayed is indicative. It is clear that the course instructor is not obliged to strictly adhere to this schedule or the arrangement of chapters.

Chapter 1. DC Regime and Fundamental Theorems 3 weeks
Definitions (dipole, branch, node, mesh), voltage and current sources (ideal, real), voltage-current relationships (R, L, C), voltage divider, current divider. Fundamental theorems: superposition, Thevenin, Norton, Millmann, Kennelly, equivalence between Thevenin and Norton, maximum power transfer theorem.

Chapter 2. Passive Quadripoles 3 weeks
Representation of a passive network by a quadripole. Parameters characterizing the behavior of a quadripole in a circuit (input and output impedance, voltage and current gain), application to matching. Passive filters (low-pass, high-pass, ...), gain curve, phase curve, cutoff frequency, bandwidth.

Chapter 3. Diodes 3 weeks
Elementary reminders on semiconductor physics: definition of a semiconductor, crystalline Si, doping, N and P semiconductors, PN junction, construction and operation of a diode, forward and reverse bias, current-voltage characteristic, static and dynamic regime, equivalent circuit. Applications of diodes: single and double alternation rectification. Voltage stabilization by the Zener diode. Clipping, other types of diodes: Varicap, LED, photodiode.

Chapter 4. Bipolar Transistors 3 weeks
Bipolar transistors: transistor effect, operating modes (cut-off, saturation, ...), static characteristic network, polarizations, load line, operating point, ... Study of the three fundamental configurations: CE, CB, CC, equivalent circuit, voltage gain, gain in decibels, bandwidth, current gain, input and output impedances. Study of multi-stage BF amplifiers in static and dynamic regimes, coupling capacitors, decoupling capacitors. Other uses of the transistor: Darlington configuration, switching transistor, ...

Chapter 5 - Operational amplifiers: 3 weeks
Principle, equivalent circuit, ideal op-amp, feedback, characteristics of the op-amp, basic op-amp circuits: inverter, non-inverter, adder, subtractor, comparator, follower, differentiator, integrator, logarithmic, exponential, ...

Mode of evaluation:
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.

Semester: 3
Teaching unit: UEF 2.1.2
Subject 2: Fundamentals of Electrotechnics 1
VHS (Total Hours): 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
To understand the basic principles of electrotechnics. To comprehend the operating principles of transformers and electric machines.

Recommended prerequisites:
Basic knowledge of electricity.

Course contents:
Chapter 1. Mathematical review of complex numbers (CN) (1 week)
Cartesian form, conjugate of CN, module, arithmetic operations on CN (addition, etc.), geometric representation, trigonometric form, De Moivre's formula, root of CN, exponential representation of a CN, trigonometric application of Euler's formulas, electrical applications of CN.

Chapter 2. Review of the fundamental laws of electricity (2 weeks)
DC circuits: electric dipole, R, C, L dipole association.
AC circuits: representation of sinusoidal quantities, mean and effective values, Fresnel representation, complex notation, impedance, powers in sinusoidal regime (instantaneous, active, apparent, reactive), Boucherot's theorem.
Transient regime: RL circuit, RC circuit, RLC circuit, charging and discharging of a capacitor.

Chapter 3. Electric circuits and power (3 weeks)
Single-phase electric circuits and power. Three-phase systems: balanced and unbalanced (symmetrical components) and power.

Chapter 4. Magnetic circuits (3 weeks)
Magnetic circuits in sinusoidal AC regime. Self and mutual inductance. Electrical-magnetic analogy.

Chapter 5. Transformers (3 weeks)
Ideal single-phase transformer. Real single-phase transformer. Other transformers (isolation, impulse, autotransformer, three-phase transformers).

Chapter 6. Introduction to electric machines (3 weeks)
Generalities on electric machines. Operating principles of the generator and motor. Power balance and efficiency.

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

Bibliographical references:
(Selon la disponibilité de la documentation au niveau de l'établissement, Sites internet...etc.)

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

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

Semester: 3
Teaching Unit: UEM2.1
Subject 1: Probability and Statistics
VHS: 45h00 (Lectures: 1h30, Tutorials: 1h30)
Credits: 4
Coefficient: 2

Objectives of the Subject
This module enables students to understand the essential concepts of probability and statistics, namely: statistical series with one and two variables, probability on a finite universe, and random variables.

Recommended Prerequisites
Mathematics 1 and Mathematics 2

Subject Contents:
Part A: Statistics
Chapter 1: Basic Definitions (1 week)
A.1.1 Concepts of population, sample, variables, modalities
A.1.2 Different types of statistical variables: qualitative, quantitative, discrete, continuous.

Chapter 2: Statistical Series with One Variable (3 weeks)
A.2.1 Frequency, Percentage, and Effectiveness.
A.2.2 Cumulative frequency and cumulative effectiveness.
A.2.3 Graphical representations: bar chart, pie chart, stick chart. Polygon of effectiveness (and frequencies). Histogram. Cumulative curves.
A.2.4 Position characteristics
A.2.5 Dispersion characteristics: range, variance, standard deviation, and coefficient of variation.
A.2.6 Shape characteristics.

Chapter 3: Statistical Series with Two Variables (3 weeks)
A.3.1 Data tables (contingency table). Scatter plot.
A.3.2 Marginal and conditional distributions. Covariance.
A.3.3 Linear correlation coefficient. Regression line and Mayer's line.
A.3.4 Regression curves, regression corridor, and correlation ratio.
A.3.5 Functional adjustment.

Part B: Probabilities
Chapter 1: Combinatorial Analysis (1 week)
B.1.1 Arrangements
B.1.2 Combinations
B.1.3 Permutations.

Chapter 2: Introduction to Probabilities (2 weeks)
B.2.1 Algebra of events
B.2.2 Definitions
B.2.3 Probabilistic spaces
B.2.4 General probability theorems

Chapter 3: Conditioning and Independence (1 week)

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

Chapter 4: Random Variables (1 week)
B.4.1 Definitions and properties,
B.4.2 Cumulative distribution function,
B.4.3 Mathematical expectation,
B.4.4 Covariance and moments.

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

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

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

Semester: 3
Teaching unit: UEM2.1
Subject 2: Computer Science 3
Lecture hours: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Objectives of the subject:
To teach the student programming using easily accessible software (primarily: Matlab, Scilab, Maple, etc.). This subject will be a tool for carrying out numerical methods labs in S4.

Recommended prerequisites:
Basic programming knowledge acquired in Computer Science 1 and 2.

Subject content:
Lab 1: Presentation of a scientific programming environment (1 week)
(Matlab, Scilab, etc.)
Lab 2: Script files and data types and variables (2 weeks)
Lab 3: Reading, displaying, and saving data (2 weeks)
Lab 4: Vectors and matrices (2 weeks)
Lab 5: Control statements (for and while loops, if and switch statements) (2 weeks)
Lab 6: Function files (2 weeks)
Lab 7: Graphics (management of graphical windows, plot) (2 weeks)
Lab 8: Use of toolboxes (2 weeks)

Assessment method:
Continuous assessment: 100%.

Bibliographic references:

1. Jean-Pierre Grenier, Débuter en algorithmique avec MATLAB et SCILAB, Ellipses, 2007.
2. Laurent Berger, Scilab de la théorie à la pratique, 2014.
3. Bégyn Arnaud, Gras Hervé, Grenier Jean-Pierre, Programmation et simulation en Scilab, 2014.
4. Thierry Audibert, Amar Oussalah, Maurice Nivat, Informatique : Programmation et calcul scientifique en Python et Scilab classes préparatoires scientifiques 1er et 2e années, Ellipses, 2010.

Semester: 3
Teaching unit: UEM 2.1
Subject 3: Electronics and Electrotechnics Labs
Lecture hours: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

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

Recommended prerequisites:
Fundamental electronics. Fundamental electrotechnics.

Subject content:
The lab instructor is required to carry out at least 3 electronics labs and 3 electrotechnics labs from the list of labs proposed below:

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

Electrotechnics labs 1
Lab 1: Measurement of voltages and currents in single-phase circuits
Lab 2: Measurement of voltages and currents in three-phase circuits
Lab 3: Measurement of active and reactive power in three-phase circuits
Lab 4: Magnetic circuits (hysteresis cycle)
Lab 5: Tests on transformers
Lab 6: Electric machines (demonstration).

Assessment method:
Continuous assessment: 100%.

Bibliographic references:

Semester: 3
Teaching Unit: UEM 2.1
Subject 4: Waves and Vibrations Lab
VHS: 15h00 (Lab: 1h00)
Credits: 1
Coefficient: 1

Teaching Objectives
The objectives assigned by this program are to initiate students in the practical application of knowledge received on mechanical vibrations phenomena restricted to low amplitude oscillations for one or two degrees of freedom, as well as the propagation of mechanical waves.

Recommended Prior Knowledge
Vibrations and Waves, Mathematics 2, Physics 1, Physics 2.

Subject Content:

Lab 1: Mass-Spring System
Lab 2: Simple Pendulum
Lab 3: Torsion Pendulum
Lab 4: Oscillating Electrical Circuit in Free and Forced Regime
Lab 5: Coupled Pendulums
Lab 6: Transverse Oscillations in Vibrating Strings
Lab 7: Hoffmann's Grooved Pulley
Lab 8: Electromechanical Systems (Electrodynamic Loudspeaker)
Lab 9: Pohl's Pendulum
Lab 10: Longitudinal Wave Propagation in a Fluid.

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

Assessment Method:
Continuous assessment: 100%.

Bibliographic References:

Semester: 3
Teaching unit: UED 2.1
Subject 1: State of the art of Electrical Engineering
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives
To give students a general overview of the different fields of Electrical Engineering, while highlighting the impact of electricity on improving human daily life.

Recommended prerequisites
None

Subject content:

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

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

Assessment method:
Final exam: 100%.

Bibliographic references:
(According to the availability of documentation at the institution, websites, etc.)

Semester: 3
Teaching unit: UED 2.1
Subject 2: Energy and Environment
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
To acquaint the student with the different existing energies, their sources, and the impact of their use on the environment.

Recommended prior knowledge:
Notions of energy and environment.

Subject content:

Chapter 1: The 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: 3
Teaching Unit: UET 2.1
Subject 1: Technical English
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
This course aims to enable the student to acquire a significant level of language proficiency, which would allow them to use scientific documents and speak about their specialty and field of study in English, at least with some ease and clarity.

Recommended prerequisite knowledge:
English 1 and English 2

Content of the subject:

Oral comprehension and expression, acquisition of vocabulary, grammar, etc.
Nouns and adjectives, comparatives, following and giving instructions, identifying things.
Use of numbers, symbols, equations.
Measurements: length, surface, volume, power, etc.
Describing scientific experiments.
Characteristics of scientific texts.

Evaluation method:
Final exam: 100%.

Bibliographical references:

1. J. Upjohn, S. Blattes, V. Jans, Minimum Competence in Scientific English, Office des Publications Universitaires, 1994.
2. A.J. Herbert, The Structure of Technical English, Longman, 1972.
3. Test of English as a Foreign Language – Preparation Guide, Cliffs, 1991.
4. Cambridge – First Certificate in English, Cambridge books, 2008.
5. K. Wilson, Th. Healy, First Choice, Oxford, 2007.
6. M. Mann, S. Tayore-Knowles, Destination: Grammar & Vocabulary with Answer Key, MacMillan, 2006.
7. P. Charles Brown, Norma D. Mullen, English for Computer Science, Oxford University Press, 1989.
8. Graeme Kennedy, Structure and Meaning in English: A Guide for Teachers, Pearson, 2004.
9. Anne M. Hanson, Brain-Friendly Strategies for Developing Student Writing Skills, 2nd Edition, Corwin Press, 2008.
10. Ann Bridges, How to Pass Higher English, Hodder Gibson-Hachette, 2009.

Semester: 4
Teaching Unit: UEF 2.2.1
Subject 1: Fundamental Electrotechnics 2
VHS: 67h30 (Lectures: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:
Master the calculation of single-phase and three-phase power. Know the different coupling modes. Determine the elements of equivalent models. Master the operation of different machines.

Recommended prerequisites:
Fundamental Electrotechnics 1

Subject content:

Chapter 1: Review of magnetostatics and magnetic circuits (1 week)

Chapter 2: Transformer (4 weeks)
Overview, Working principle of the single-phase transformer, Ideal transformer, Calculation of induced electromotive force, Impedance matching, Real transformer, Transformer in the Kapp approximation, Evaluation of voltage drop at the secondary, Energy balance and efficiency, Measurements for efficiency calculation, Three-phase transformer, Different types of coupling and hourly index.

Chapter 3: Direct current machines (4 weeks)
Overview, Working principle - Constitution, Direct current generator - characteristic equations, Calculation of electromotive force and torque, Different excitation modes, Direct current motor - working principle, energy balance and efficiency.

Chapter 4: Synchronous machines (3 weeks)
Overview, Notion of rotating magnetic field, Working principle - Constitution of the machine, Operation as an alternator, Magnetic reaction of the armature, Behn Eschenburg diagram, Energy balance and efficiency.

Chapter 5: Asynchronous machines (3 weeks)
Working principle - Constitution of asynchronous machines, Equation formulation and equivalent single-phase diagram, Torque and mechanical characteristics, Energy balance and efficiency, Simplified circle diagram.

Assessment:
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
Subject 2: Combinatorial and Sequential Logic
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:
To understand common combinational circuits. To be able to design some applications of combinational circuits using standard tools such as truth tables and Karnaugh maps. To introduce sequential circuits through flip-flops, counters, and registers.

Recommended Prerequisites:
None.

Course Contents:
The number of weeks displayed is indicative. The course instructor is not obliged to strictly adhere to this schedule or the arrangement of chapters.

Chapter 1: Boolean Algebra and Simplification of Logical Functions 2 weeks
Logical variables and functions (OR, AND, NOR, NAND, XOR). Laws of Boolean algebra. De Morgan's theorem. Complete and incomplete logical functions. Representation of logical functions: truth tables, Karnaugh maps. Simplification of logical functions: algebraic method, Karnaugh map method.

Chapter 2: Number Systems and Information Coding 2 weeks
Representation of a number using codes (binary, hexadecimal, DCB, signed and unsigned binary, etc.), base conversion, non-weighted codes (Gray code, error detection and correction codes, ASCII code, etc.), arithmetic operations in binary code.

Chapter 3: Transcoder Combinational Circuits 2 weeks
Definitions, decoders, priority encoders, transcoders, Cascade connection, Applications, Analysis of the datasheet of a decoder integrated circuit, List of decoding integrated circuits.

Chapter 4: Switching Combinational Circuits 2 weeks
Definitions, multiplexers, demultiplexers, Cascade connection, Applications, Analysis of the datasheet of a switching integrated circuit, List of switching integrated circuits.

Chapter 5: Comparison Combinational Circuits 2 weeks
Definitions, 1-bit, 2-bit, and 4-bit comparison circuits, Cascade connection, Applications, Analysis of the datasheet of a comparison integrated circuit, List of comparison integrated circuits.

Chapter 6: Flip-Flops 2 weeks
Introduction to sequential circuits. RS flip-flop, RST flip-flop, D flip-flop, Master-slave flip-flop, T flip-flop, JK flip-flop. Examples of applications with flip-flops: n frequency divider, pulse train generator, etc.
It is recommended to present for each flip-flop the truth table, examples of timing diagrams as well as limitations and imperfections.

Chapter 7: Counters 2 weeks

Definition, Classification of counters (synchronous, regular, irregular, asynchronous, complete and incomplete cycles). Implementation of complete and incomplete synchronous binary counters, Excitation tables of JK, D and RS flip-flops, Implementation of asynchronous binary counters modulo (n): complete, incomplete, regular, and irregular. Programmable counters (starting from any state).

Chapter 8: Registers 1 week

Introduction, classical registers, shift registers, loading and retrieving data into a register (PIPO, PISO, SIPO, SISO), shifting data in a register, universal register, 74LS194A, available integrated circuits, Applications: classical registers, special counters, queues.

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.

Semester: 4
Teaching Unit: UEF 2.2.1
Subject 2: Combinatorial and Sequential Logic
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:
To understand common combinational circuits. To be able to design some applications of combinational circuits using standard tools such as truth tables and Karnaugh maps. To introduce sequential circuits through flip-flops, counters, and registers.

Recommended Prerequisites:
None.

Course Contents:
The number of weeks displayed is indicative. The course instructor is not obliged to strictly adhere to this schedule or the arrangement of chapters.

Chapter 1: Boolean Algebra and Simplification of Logical Functions 2 weeks
Logical variables and functions (OR, AND, NOR, NAND, XOR). Laws of Boolean algebra. De Morgan's theorem. Complete and incomplete logical functions. Representation of logical functions: truth tables, Karnaugh maps. Simplification of logical functions: algebraic method, Karnaugh map method.

Chapter 2: Number Systems and Information Coding 2 weeks
Representation of a number using codes (binary, hexadecimal, DCB, signed and unsigned binary, etc.), base conversion, non-weighted codes (Gray code, error detection and correction codes, ASCII code, etc.), arithmetic operations in binary code.

Chapter 3: Transcoder Combinational Circuits 2 weeks
Definitions, decoders, priority encoders, transcoders, Cascade connection, Applications, Analysis of the datasheet of a decoder integrated circuit, List of decoding integrated circuits.

Chapter 4: Switching Combinational Circuits 2 weeks
Definitions, multiplexers, demultiplexers, Cascade connection, Applications, Analysis of the datasheet of a switching integrated circuit, List of switching integrated circuits.

Chapter 5: Comparison Combinational Circuits 2 weeks
Definitions, 1-bit, 2-bit, and 4-bit comparison circuits, Cascade connection, Applications, Analysis of the datasheet of a comparison integrated circuit, List of comparison integrated circuits.

Chapter 6: Flip-Flops 2 weeks
Introduction to sequential circuits. RS flip-flop, RST flip-flop, D flip-flop, Master-slave flip-flop, T flip-flop, JK flip-flop. Examples of applications with flip-flops: n frequency divider, pulse train generator, etc.
It is recommended to present for each flip-flop the truth table, examples of timing diagrams as well as limitations and imperfections.

Chapter 7: Counters 2 weeks

Definition, Classification of counters (synchronous, regular, irregular, asynchronous, complete and incomplete cycles). Implementation of complete and incomplete synchronous binary counters, Excitation tables of JK, D and RS flip-flops, Implementation of asynchronous binary counters modulo (n): complete, incomplete, regular, and irregular. Programmable counters (starting from any state).

Chapter 8: Registers 1 week

Introduction, classical registers, shift registers, loading and retrieving data into a register (PIPO, PISO, SIPO, SISO), shifting data in a register, universal register, 74LS194A, available integrated circuits, Applications: classical registers, special counters, queues.

Assessment Method:

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

Bibliographic References:

1. C. Brezinski, Introduction à la pratique du calcul numérique, Dunod, Paris 1988.
2. G. Allaire et S.M. Kaber, Algèbre linéaire numérique, Ellipses, 2002.
3. G. Allaire et S.M. Kaber, Introduction à Scilab. Exercices pratiques corrigés d'algèbre linéaire, Ellipses, 2002.
4. G. Christol, A. Cot et C.-M. Marle, Calcul différentiel, Ellipses, 1996.
5. M. Crouzeix et A.-L. Mignot, Analyse numérique des équations différentielles, Masson, 1983.
6. S. Delabrière et M. Postel, Méthodes d'approximation. Équations différentielles. Applications Scilab, Ellipses, 2004.
7. J.-P. Demailly, Analyse numérique et équations différentielles. Presses Universitaires de Grenoble, 1996.
8. E. Hairer, S. P. Norsett et G. Wanner, Solving Ordinary Differential Equations, Springer, 1993.
9. P. G. Ciarlet, Introduction à l'analyse numérique matricielle et à l'optimisation,

Masson, Paris, 1982.

Semester: 4
Teaching unit: UEF 2.2.2
Subject 2: Signal theory
VHS: 45 hours (Lecture: 1.5 hours, Tutorial: 1.5 hours)
Credits: 4
Coefficient: 2
Teaching objectives:
To acquire basic knowledge of the mathematical tools used in signal processing.

Recommended prerequisites:
Basic mathematics course.

Subject content:
Chapter 1. Generalities on signals (3 weeks)
Objectives of signal processing. Areas of application. Classification of signals (morphological, spectral, etc.). Deterministic signals (periodic and non-periodic) and random signals (stationary and non-stationary). Causality. Notions of power and energy. Basic functions in signal processing (measurement, filtering, smoothing, modulation, detection, etc.). Examples of basic signals (rectangular pulse, triangular pulse, ramp, step, sign, Dirac, etc.)

Chapter 2. Fourier analysis (4 weeks)
Introduction, Mathematical reminders (scalar product, Euclidean distance, linear combination, orthogonal basis, etc.). Approximation of signals by a linear combination of orthogonal functions. Fourier series, Fourier transform, properties. Parseval's theorem. Fourier spectrum of periodic (discrete spectrum) and non-periodic (continuous spectrum) signals.

Chapter 3. Laplace transform (3 weeks)
Definition. Properties of the Laplace transform. Signal/system relationship. Application to linear and time-invariant systems (temporal and frequency analysis).

Chapter 4. Convolution product (2 weeks)
Formulation of the convolution product, Properties of the convolution product, Convolution product and Dirac impulse.

Chapter 5. Signal correlation (3 weeks)
Signals with finite total energy. Signals with finite total mean power. Inter-correlation between signals, Auto-correlation, 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, "Théorie et traitement des signaux", Edition PPUR.
4. F. Cottet, "Traitement des signaux et acquisition de données, Cours et exercices résolus", Dunod.
5. B. Picinbono, "Théorie des signaux et des systèmes avec problèmes résolus", Edition Bordas.
6. M. Benidir, "Théorie et Traitement du signal, tome 1 : Représentation des signaux et des systèmes - Cours et exercices corrigés'', Dunod, 2004.

7. M. Benidir, “Théorie et Traitement du signal, tome 2 : Méthodes de base pour l’analyse et le traitement du signal - Cours et exercices corrigés’’, Dunod, 2004.
8. J. Max, Traitement du signal

Semester: 4
Teaching Unit: UEM 2.2
Subject 1: Electrical and Electronic Measurements
Contact Hours: 37h30 (Lectures: 1h30, Lab: 1h00)
Credits: 3
Coefficient: 2

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

Recommended prerequisites:
General Electricity, Fundamental laws of Physics.

Subject Content:
The number of weeks displayed is indicative. It is clear that the course instructor is not required to strictly adhere to this schedule or chapter arrangement.

Chapter 1. Measurements, Quantities and Uncertainties 5 weeks
Introduction, Quantity, Standard, Unit systems, Multiples and submultiples table, Dimensional equations, Useful formulas, Measurement accuracy, Measurement error, Classification of errors, Uncertainties in indirect measurements, Quality of measuring instruments, Calibration of measuring instruments, Graphical symbols of measuring instruments, General methods of measurement (Deviation, Zero and Resonance methods), Application exercises.

Chapter 2. Measurement Methods 6 weeks

Measurement of Voltages: Direct methods of voltage measurement, Alternating voltage measurement, Indirect method of voltage measurement by opposition method.
Measurement of Currents: Direct method of current measurement, Using simple shunt.
Measurement of Resistances: Resistance classification, Voltammetric method, Zero method: Wheatstone bridge, Measurement of very high resistances by the loss of charge method.
Measurement of Impedances: Capacitance measurements, Inductance measurements, Alternating Bridges.
DC Power Measurements: Fundamental relationship, Method of ammeter and voltmeter, Electrodynamometer wattmeter in DC.
AC Power Measurements: Instantaneous power and average power, Complex power, Apparent power, Active power and Reactive power, Electrodynamometer wattmeter in AC, Three voltmeter method for active power measurement, Direct measurement method for reactive power, Indirect measurement method for reactive power.
Phase Shift Measurements: Direct measurement of phase shift on the oscilloscope, Phase shift measurement with Lissajous figures.
Frequency and Period Measurements: Direct frequency measurement on the oscilloscope, Frequency measurement with Lissajous figures, Frequency measurement by frequency meter method, Frequency measurement by period meter method, Application exercises.
Chapter 3. Measuring Instruments 4 weeks
Introduction
Analog measuring instruments: Classification of deflection instruments, Moving coil galvanometer, Magneto-electric ammeter structure, Magneto-electric voltmeter structure, Operating principle of AC Electrodynamometer wattmeter.

Digital measuring instruments: Analog to digital converters (ADC), Principle of operation of a digital measuring instrument, Examples of digital measuring instruments (Multimeter, Oscilloscope, etc.).
Lab: Electrical and Electronic Measurements:

Lab No. 1: Resistance measurement:
Perform resistance measurement using the following 5 methods: Voltammetric, Ohmmeter, Wheatstone bridge, Comparison and substitution.
Compare these methods and establish an error calculation.

Lab No. 2: Inductance measurement:
Perform inductance measurement using the following 3 methods: Voltammetric, Maxwell bridge, Resonance.
Compare these methods and establish an error calculation.

Lab No. 3: Capacitance measurement:
Perform capacitance measurement using the following 3 methods: Voltammetric, Sauty bridge, Resonance.
Compare these methods and establish an error calculation.

Lab 4: Phase Shift Measurement:
Perform the measurement of resistances using the following two methods: Phase meter and oscilloscope.

Lab 5: Single-phase Power Measurement:
Perform the measurement of resistances using the following five methods: Wattmeter, Cosϕ meter, three voltmeters, three ammeters, power sensor.
Compare these methods and establish an error calculation.

Lab 6: Three-phase Power Measurement:
Perform the measurement of resistances using the following methods: Star and delta systems, balanced and unbalanced.

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

Bibliographic references:

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

Sources Internet :

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

Semester: 4
Teaching Unit: UEM 2.2
Subject 2: Fundamental Electrotechnics Lab 2
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives:
To reinforce the knowledge acquired during the fundamental electronics and electrotechnics courses through practical work, in order to better understand and assimilate the fundamental laws of electrotechnics, the operation of transformers and motors.

Recommended Prerequisite Knowledge:
Fundamental Electrotechnics 2.

Subject Content:

Lab No. 1: No-load, loaded, and short-circuit tests on a single-phase transformer.

Lab No. 2: Load test on a three-phase transformer.

Lab No. 3: Characteristics of a DC generator: shunt and separately excited, self-excitation.

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: Determination of the circle diagram of an asynchronous machine.

Lab No. 7: Alternator - operating diagram.

Evaluation Method:
Continuous assessment: 100%.

Bibliographic References:
(Books and course notes, websites, etc.)

Semester: 4
Teaching Unit: UEM 2.2
Subject 3: Combinatorial and Sequential Logic Lab
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:
To reinforce the knowledge acquired during the Combinatorial and Sequential Logic course through practical work to better understand and assimilate the content of this subject.

Recommended prerequisites:
Combinatorial and Sequential Logic.

Subject content:
The teacher chooses between 4 and 6 lab exercises from this list that deal with both types of logic circuits (combinatorial and sequential).

Lab 1: TTL and CMOS integrated circuit technology.
Understanding and testing different logic gates.

Lab 2: Simplification of logical equations through practice.
Discovering the rules of equation simplification in Boolean algebra through practical exercises.

Lab 3: Study and implementation of usual combinational logic functions.
Examples: switching circuits (MUX, DMUX), encoding and decoding circuits, etc.

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

Lab 5: Study and implementation of a combinational logic circuit.
Implementation of a logic function using logic gates. Examples include a 7-segment display and/or a 4-bit two's complement generator and/or a 4-bit Gray code generator.

Lab 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 given specification.

Lab 7: Study and implementation of counter circuits.
Incomplete asynchronous counter circuits using flip-flops, irregular cycle synchronous counter circuits using flip-flops.

Lab 8: Study and implementation of registers.

Assessment method:
Continuous assessment: 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: UEM 2.2
Subject 4: Numerical Methods Laboratory
VHS: 22h30 (Laboratory: 1h30)
Credits: 2
Coefficient: 1

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

Recommended prerequisites:
Numerical Methods, Computer Science 2, and Computer Science 3.

Subject Content:
Chapter 1: Nonlinear Equation Solving 3 weeks

Bisection Method, 2. Fixed-Point Method, 3. Newton-Raphson Method
Chapter 2: Interpolation and Approximation 3 weeks

Newton Interpolation, 2. Chebyshev Approximation
Chapter 3: Numerical Integration 3 weeks

Rectangle Method, 2. Trapezoidal Method, 3. Simpson's Method
Chapter 4: Differential Equations 2 weeks

Euler's Method, 2. Runge-Kutta Methods
Chapter 5: Linear Equation Systems 4 weeks

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.

Semester: 4
Teaching unit: UED2.2
Subject 1: Electricity production
VHS: 22h30 (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
To understand, master, and acquire the basic principles of various modes of electricity production. At the end of this subject, the student should be aware of the energy issue in general and the impact of electricity on socio-economic life, in particular.

Recommended prerequisite knowledge:
Have knowledge of thermodynamics and fluid mechanics and especially basic knowledge of fundamental electrotechnics (electricity and circuits, electric and magnetic fields, power, three-phase systems, alternators, motors, transformers).

Subject 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 energy, 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 principles, interfacing with the grid, voltage protection, and regulation.

Chapter 7. Solar energy (2 weeks)
Operating principles and technologies, characteristics, and optimum operating point.

Chapter 8. Fuel cells (1 week)
Types of fuel cells and operating principles.

Assessment method:
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.

Semester: 4
Teaching Unit: UED2.2
Subject 2: Electrical Safety
VHS: 22.5 hours (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1

Teaching Objectives
The objective of this course is to inform future graduates about the nature of electrical accidents, the methods of rescuing electrical accident victims, and to provide them with sufficient knowledge to best size the protection devices for equipment and personnel operating in industry and other areas where these types of equipment are used.

Recommended Prerequisite Knowledge:
Basic knowledge of electricity.

Course Content:

Chapter 1: Electrical Risks (2 weeks)
Definition and purpose of work safety, Legend and history of electrical risk, Standardization organizations, Statistics on electrical accidents.

Chapter 2: Nature of Electrical Accidents and Dangers of Electric Current (3 weeks)
Classification (direct and indirect effects of electric current), Impedance of the human body, Parameters influencing human current, Pathophysiological effects of electric current passage, Electrization without loss of consciousness, Electrization with loss of consciousness (ventricular fibrillation).

Chapter 3: Protection Measures (6 weeks)
Introduction, Protection of people, Regulations, Safety measures, Work on de-energized equipment, Work in the vicinity of electrical installations, Individual and collective protections, Protection against direct and indirect currents, Safety voltage, Earthing system, Effects of electric and magnetic fields, Equipment protection, Protection devices (types and reliability of devices), Low voltage, Medium voltage and High voltage indoor installations, Low voltage mobile devices, Verifications and checks.

Chapter 4: Safety Measures against Indirect Effects of Electric Current (2 weeks)
Fires, Harmful substances, Explosions, Noise and vibrations (Definition, standards and techniques for combating noise).

Chapter 5: Rescue and Care Measures (2 weeks)
Attitude to adopt in case of electrical accidents, First aid, Assisted ventilation (mouth-to-mouth and Sylvester's methods), External cardiac massage, Care for burns.

Assessment Method:
Final exam: 100%.

Bibliographical References:

-V. Semeneko, Prescriptions Générale de Sécurité Technique dans une Entreprise, Université de Annaba, 1979.
2- A.Novikov, Cahier de Cours de Protection de Travail, Université de Annaba, 1983.
3- Edgar Gillon, Cours d'Electrotechnique, Dunod, Paris 1966.
4- Encyclopédie des Sciences industrielles, Quillet, Paris, 1983.
5- L.G. Hewitson, Guide de la protection des équipements électriques, Dunod, 2007.

Semester: 4
Teaching Unit: UET2.2
Subject: Communication Techniques, Information and Expression
VHS: 22h30 (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

This course aims to develop the student's skills, both personally and professionally, in the field of communication and expression techniques. It also enables the student to learn the techniques, tools, and methods used to facilitate communication.

Recommended Prerequisite Knowledge:
Languages (Arabic; French; English)

Course Content:

Chapter 1: Research, Analyze and Organize Information (2 weeks)
Identify and use documentary resources, tools and places, understand and analyze documents, and compile and update documentation.

Chapter 2: Improve Expression Skills (2 weeks)
Consider the communication situation, produce a written message, communicate orally, produce a visual and audiovisual message, and improve group communication skills.

Chapter 3: Develop Autonomy, Organizational and Communication Skills in a Project Approach (2 weeks)
Understand the project and communication approach, anticipate action, and implement a project: Present a report on a practical task (homework).

Chapter 4: ICT - Definition and Evolution (2 weeks)
Definition, Activities using ICT, ICT skills, Evolution of ICT, Information and Communication Services.

Chapter 5: Research, Use and Retrieval of Information (2 weeks)
Search engines (YAHOO, GOOGLE), Query and search language, Retrieval and printing of an HTML page, Retrieval of an image, Download of a file or software, Reading of an HTML file locally, Reading of a multimedia file saved on the web.

Chapter 6: ICT Rights (2 weeks)
Computer crime, Media law, Electronic communications law, E-commerce law, Internet governance, etc.

Chapter 7: Securing Sensitive Information, Protecting Confidential Data and Preserving Nuisances (3 weeks)
Backing up important data, "Information and Liberties" law, Dangers of the Internet, Computer hacking, Machine protection, Protection against viruses, Protection against cyber threats or online threats (Phishing, spam emails, spyware, malware, ransomware, viruses and trojan horses, man-in-the-middle attacks, etc.), Preventing data loss, Spam, Hoax, Cryptography, Electronic signature....

Assessment Method:
Final Exam: 100%.

Bibliographic References:
(Books, course materials, websites, etc.)

1. Jean-Denis Commeignes, 12 méthodes de communications écrites et orale – 4éme édition, Michelle Fayet et Dunod 2013.
2. Denis Baril, Sirey, Techniques de l'expression écrite et orale, 2008.
3. 3- Matthieu Dubost, Améliorer son expression écrite et orale toutes les clés, Edition Ellipses 2014.
4. Allegrezza Serge et Dubrocard Anne (edited by). Internet Econometrics. Palgrave Macmillan Ltd, 2011. ISBN-10: 0230362923 ; ISBN-13: 9780230362925
5. Anduiza Eva, Jensen J. Michael et JorbaLaja (edited by). Digital Media and Political Engagement Worldwide. Cambridge UniversityPress - M.U.A, 2012. ISBN-10: 1107668492 ; ISBN-13: 9781107668492
6. Baron G.L., et Bruillard E. L'informatique et ses usagers dans l'éducation. Paris, PUF, 1996. ISBN-10: 2130474926; ISBN-13: 978-2130474920
7. En ligneChantepie P. et Le Diberder A. Révolution numérique et industries culturelles. Repères. Paris, La Découverte, 2010. ISBN-10: 2707165050; ISBN-13: 978-2707165053
8. Dawn Medlin B. Integrations of Technology Utilization and Social Dynamics in Organizations. Information Science Reference (Isr), 2012. ISBN-10: 1-4666-1948-1; ISBN-13: 978-1-4666-1948-7
9. Devauchelle B. Comment le numérique transforme les lieux de savoirs. FYP Editions, 2012. ISBN-10: 2916571612; ISBN-13: 978-2916571614
10. Greenfield David. « The Addictive Properties of Internet Usage ». In Internet Addiction, 133?153. John Wiley & Sons, Inc., 2007. ISBN: 9780470551165. http://dx.doi.org/10.1002/9781118013991.ch8.
11. Kurihara Yutaka et [Al.]. Information technology and economic development. Information Science Reference (Isr), 2007. ISBN 10: 1599045818 ; ISBN 13: 9781599045818
12. Paquelin D. L'appropriation des dispositifs numériques de formation. Du prescrit aux usages. Paris, L'Harmattan, 2009. ISBN-10: 2296085563 ; ISBN-13: 978-2296085565
13. Tansey Stephen D. Business, information technology and society. Routledge Ltd, 2002. ISBN-10: 0415192137 ; ISBN-13: 978-0415192132

Semester: 5
Teaching Unit: UEF 3.1.1
Subject 1: Electrical Networks
VHS: 67h30 (Lectures: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives:
To provide an overview of the management and design of the electrical energy network (transport and distribution).

Recommended Prerequisites:
Basic course in fundamental electrical engineering (electricity and circuits, electric and magnetic fields, power, three-phase regime, 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, current and voltage measuring transformers, circuit breakers, isolators, other equipment in a substation, etc.)
- Other elements of the network (supports, conductor cables, overhead lines, underground lines, guard cables, busbars, insulators); Dispatching center.

Chapter II: Modes of transport, distribution, and delivery of electrical energy (2 weeks)

- Description of electrical networks (structure of electrical networks, voltage level);
- Topology of electrical networks (high and medium voltage source substations, medium voltage networks, high and low voltage substations, low voltage networks).

Chapter III: Modeling of electrical lines (5 weeks)

- Longitudinal characteristics (resistance, longitudinal reactance, concept of mean geometric radius and mean geometric distance);
- Transverse characteristics (transverse reactance, conductance due to corona effect);
- Calculation of electrical networks (general operating equations, equivalent circuits, calculation of voltage drop, Ferranti effect);
- Transmission power and power factor correction in lines.

Chapter IV: Transformers and 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 (interest, conditions, hourly index);
- Main types of transformers (current measurement, voltage measurement, on-load tap changer, phase shifter, three-winding and autotransformer);
- Relative unit system (basic quantities (power, voltage, impedance), choice of base, change of base).

Chapter V: Calculation of short-circuit currents (5 weeks)

- Calculation of short-circuit currents (causes, consequences, different types, concept of symmetrical and asymmetrical short circuits, etc.);

- Calculation of short-circuit currents using symmetrical components (symmetrical component method, construction of sequential networks, etc.);
- Equivalent impedances of network elements.

References:

[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 ;

[18] B. DE METZ-NOBLAT, 'Analyse des réseaux triphasés en régime perturbé à l'aide des composantes symétriques', cahier technique Schneider N°: 18, 2002 ;

Semester: 5
Teaching unit: UEF 3.1.1
Subject 2: Power Electronics
Total hours: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

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

Recommended prerequisites:
Fundamental Electronics 1, Fundamental Electrotechnics 1.

Subject content:
The number of weeks displayed is indicative. It is understood that the course instructor is not required to strictly adhere to this dimensioning or arrangement of chapters.

Chapter 1. Introduction to Power Electronics 3 weeks
Introduction to power electronics, its role in electric energy conversion systems. Introduction to static converters. Classification of static converters (according to switching mode, according to conversion mode). Non-sinusoidal periodic quantities (effective values, averages, form factors, ripple factors).

Chapter 2. AC-DC Converters 3 weeks
Power components (diodes and thyristors), single-phase rectification, R, RL, RLE type loads, three-phase rectifiers, R, RL, RLE type loads. Analysis of the switching (overlapping) phenomenon in uncontrolled and controlled rectifier static converters.

Chapter 3. AC-AC Converters 3 weeks
Power components (triacs with a quick reminder on diodes and thyristors), single-phase dimmer with R, RL load. Principle of single-phase cycloconverter.

Chapter 4. DC-DC Converters 3 weeks
Power components (GTO thyristor, bipolar transistor, MOSFET transistor, IGBT transistor), buck and boost converters with R, RL, and RLE loads.

Chapter 5. DC-AC Converters 3 weeks
Single-phase inverter, half-bridge and full-bridge configurations with R and RL loads.

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

References:

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

5. D. Jacob, « Electronique de puissance - Principe de fonctionnement, dimensionnement », Ellipses Marketing, 2008.
6. G. Séguier, « L'électronique de puissance, les fonctions de base et leurs principales applications », Tech et Doc.
7. H. Buhler, « Electronique de puissance », Dunod
8. C.W. Lander, « Electronique de puissance », McGraw-Hill, 1981
9. H. Buhler, « Electronique de Réglage et de commande ; Traité d'électricité ».
10. F. Mazda, "Power Electronics Handbook: Components, Circuits and Application", 3rd Edition, Newness, 1997.
11. R. Chauprade, « Commandes des moteurs à courant alternatif (Electronique de puissance) », 1987.
12. R. Chauprade, « Commandes des moteurs à courant continu (Electronique de puissance) », 1984.

Semester: 5
Teaching unit: UEF 3.1.2
Subject 1: Controlled Systems
VHS: 45h00 (Lectures: 1h30, Tutorials: 1h30)
Credits: 4
Coefficient: 2

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

Recommended prerequisites:
Basic mathematics (algebra, integral and differential calculus, analysis, complex numbers, etc.). Fundamental concepts of signal processing, basic electronics (linear circuits).

Subject content:
Chapter 1. Introduction to controlled systems (2 weeks)
History of automatic control systems, terminology and definition, system concept, dynamic behavior, static behavior, static systems, dynamic systems, linear systems, introductory examples, open-loop systems, closed-loop systems, main elements of a control chain, reasoning for control, performance of controlled systems.

Chapter 2. Modeling of systems (4 weeks)
Representation of systems by their differential equations, Laplace transform, from differential equation to transfer function, functional blocks and subsystems, simplification rules, state representation of the system, correspondence between state representation and transfer function, calculation of transfer functions of closed-loop systems.

Chapter 3. Time responses of linear systems (3 weeks)
Definition of a system's response, transient regime, steady-state regime, stability concepts, speed and static precision, impulse response (1st and 2nd order), temporal characteristics, step response (1st and 2nd order), identification of first and second-order systems from time response, higher-order systems, influence of poles and zeros on the response of a system.

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 controlled systems (3 weeks)
Definition, stability conditions, Routh-Herwitz algebraic criterion, reversal criteria in Nyquist and Bode plots, stability margins, precision of controlled systems, static precision, calculation of static error, dynamic precision, characterization of transient regime.

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

Bibliographic references:

1. E. K. Boukas, Systèmes asservis, Editions de l'école polytechnique de Montréal, 1995.
2. P. Clerc. Automatique continue, échantillonnée : IUT Génie Electrique-Informatique Industrielle, BTS Electronique-Mécanique-Informatique, Editions Masson (198p), 1997.
3. Ph. de Larminat, Automatique, Editions Hermes 2000.
4. P. Codron et S. Leballois, Automatique : systèmes linéaires continus, Editons Dunod 1998.
5. Y. Granjon, Automatique : Systèmes linéaires, non linéaires, à temps continu, à temps discret, représentation d'état, Editions Dunod 2001.
6. K. Ogata, Modern control engineering, Fourth edition, Prentice Hall International Editions 2001.
7. B. Pradin, Cours d'Automatique. INSA de Toulouse, 3ème année spécialité GII.
8. M. Rivoire et J.-L. Ferrier, Cours d'Automatique, tome 2 : asservissement, régulation, commande analogique, Editions Eyrolles 1996.
9. Y. Thomas, Signaux et systèmes linéaires : exercices corrigées, Editions Masson 1993.
10. Y. Thomas. Signaux et systèmes linéaires, Editions Masson 1994.

Semester: 5
Teaching Unit: UEF 3.1.2
Subject 2: Electromagnetic Field Theory
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:
To deepen and consolidate concepts in electromagnetism. To understand the physical and mathematical tools needed to comprehend Maxwell's equations and the propagation of waves.

Recommended Prerequisites:
Vector calculus, knowledge of gradient, divergence and curl - Electrostatics and magnetostatics.

Subject Content:
Chapter 0: Vector Concepts: (1 Week)
Physical definition of gradient, divergence and curl, Vector and Pseudo-vector, Vector operators, Stokes' and Ostrogradsky's theorems, Solid angle concept.
Chapter 1: Electrostatics: (3 Weeks)
Maxwell's equations in electrostatics, Dielectric media relation, Electric charge distribution, Force, Symmetry considerations, Gauss' theorem, Electric flux, Electric scalar potential, Boundary and continuity conditions, Poisson and Laplace equations in electrostatics, Coulomb's law, Electrostatic energy, Capacitance, Electrostatic dipole.
Chapter 2: Magnetostatics: (3 Weeks)
Maxwell's equations in magnetostatics, Magnetic media relation, Electric current distribution, Symmetry considerations, Ampere's theorem, Magnetic flux, Magnetic vector potential, Boundary and continuity conditions, Poisson and Laplace equations in magnetostatics, Biot-Savart 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 arbitrary variable regimes, Maxwell-Faraday law (Faraday and Lenz's law) and Lorentz gauge, Propagation equation of electric and magnetic fields, Propagation equation of electric scalar and magnetic vector potentials, Boundary and continuity conditions, Solution of propagation equations (retarded potentials), Electromagnetic energy and Poynting vector.
Chapter 4: Slowly Variable Regime - Electromagnetic Induction: (3 Weeks)
Approximation of quasi-stationary regimes "ARQS", Conducting and displacement currents, and Maxwell-Ampere equation, Conservation and relaxation of electric charge in conductors, Local Ohm's law, Magneto-dynamic equation, Coupled electrical circuits, Neumann's induction, Lorentz's induction, Laplace's action, Magnetic energy and co-energy.
Chapter 5: Rapidly Variable Regime - Wave Propagation: (2 Weeks)
Propagation equation of any wave, Plane wave and its characteristics, Propagation in any direction (velocity and wavelength), Transmission and reflection of waves, Guided waves, Electromagnetic radiation spectrum, Propagation of electromagnetic energy.

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

Bibliographical references:

1. Rosnel, "Eléments de propagation électromagnétique, physique fondamentale", Mc GRAW-HILL, 2002.
2. Garing, "Ondes électromagnétiques dans les milieux diélectriques, Exercices et problèmes corrigés", 1998.
3. Paul Lorrain, Dale Corson, and François Lorrain, "Les Phénomènes électromagnétiques : Cours, exercices et problèmes résolus", 2002.
4. Louis de Broglie, "Ondes Electromagnétiques et Photons",1968.
5. Garing, "Ondes électromagnétiques dans le vide et les milieux conducteurs: Exercices et problèmes corrigés", 1998.
6. Michel Hulin, "Nicole Hulin, and Denise Perrin, Equations de Maxwell: ondes électromagnétiques. Cours, exercices et problèmes résolus", 1998.

Semester: 5
Teaching Unit: UEM 3.1
Subject 1: Electrical Schematics and Apparatus
VHS: 37.5 hours (Lecture: 1.5 hours, Lab: 1 hour)
Credits: 3
Coefficient: 2

Teaching Objectives:

To learn about different types of protective and control apparatus used in electrical installations, as well as how to design an electrical installation.

Recommended Prerequisites:

Basic understanding of fundamental electricity, electrostatics, and basic magnetostatics.

Subject Contents:

Chapter I: Electrical Apparatus

- Switches (definition, function, and characteristics)
- Commutators (definition, function, and characteristics)
- Disconnectors (definition, function, and characteristics)
- Contactors (definition, function, and characteristics)
- Fuses (function and operation, types, equations)
- Thermal relays (definition, function, types, and characteristics)
- Electromagnetic relays (definition, function, types, and characteristics)
- Circuit breakers (definition, function, types, and characteristics)
- Active and passive sensors: symbols, roles, and uses

Chapter II: Electrical Schematic Design

- Standardized symbols for electrical apparatus
- Classification of schematics based on representation mode
- Conventions and standardization
- Rules and standards for establishing an electrical schematic

Chapter III. Lighting Circuits

III.1. Single-switch wiring
III.2. Double-switch wiring
III.3. Three-way switch wiring
III.4. Switching with a relay
III.5. Timer-controlled lighting
III.5.1. Principle of a timer connected in 4-wire mode
III.5.2. Principle of a timer connected in 3-wire mode

Chapter IV. Three Methods of Controlling an Electric Motor

IV.1. Direct start with single direction of rotation
IV.2. Direct start with double direction of rotation
IV.3. Star-delta starting

Laboratory Work

Lab 1: Main lighting setups

Outlet wiring, single-switch wiring, double-switch wiring, three-way switch wiring, switching with a relay, timer-controlled lighting

Lab 2: Manual control of a contactor and two contactors

Using a switch, using a push button, remotely using two impulse buttons, remotely using multiple push buttons

Lab 3: Starting a single-direction three-phase induction motor

Lab 4: Starting a double-direction three-phase induction motor
Lab 5: Star-delta starting of a three-phase induction motor

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

Bibliographical References:

1. Cahier de charge technique Schneider.
2. Cahier de charge technique Le grand.
3 http://www.yesss-fr.com/tech/symboles-electriques.php
4 http://www.repereelec.fr/dm2sm.htm
5. « Mémento de schémas électriques » ,Thierry Gallauziaux, David Fedullo
   Edition Eyrolles, collection : Les cahiers du bricolage ; 2009 (2e édition)
6. « Le Schéma Electrique » ,Hubert Largeaud, Edition Eyrolles – 1991(-3ème Édition)
7. Christophe Prévé-, "Protection des réseaux électriques", Hermès,Paris,1998.
8. S. H. Horowitz, A.G. Phadke, "Power System Relaying", second edition, John Wiley & Sons, 1995.
9. L. Féchant, "Appareillage électrique à BT, Appareils de distribution", Techniques de l'Ingénieur, traité Génie électrique, D 4 865.

Semester: 5
Teaching unit: UEM 3.1
Subject 2: Electric Networks Lab
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:
To observe and understand the behavior of an electric line, voltage drop, voltage regulation, and reactive power compensation. To establish power flow, calculate voltage drop, and understand energy transfer between two stations.

Recommended prerequisite knowledge:
Basic knowledge of electrical engineering.

Subject content:
Lab 1: Study of line efficiency and power factor improvement.

Lab 2: Voltage regulation using reactive power compensation method with capacitors.

Lab 3: DC model: Power distribution and voltage drop calculation.

Lab 4: Parallel operation of transformers.

Evaluation method:
Continuous assessment: 100%.

Bibliographic references:

1. Sabonnadière, Jean-Claude, "Lignes et réseaux électriques", Vol. 1, Lignes d'énergie électriques, 2007.
2. Sabonnadière, Jean-Claude, "Lignes et réseaux électriques", Vol. 2, Méthodes d'analyse des réseaux électriques, 2007.
3. Lasne Luc, "Exercices et problèmes d'électrotechnique: notions de bases, réseaux et machines électriques", 2011.
4. J. Grainger, "Power system analysis", McGraw Hill, 2003
5. W.D. Stevenson, "Elements of Power System Analysis", McGraw Hill, 1982.

Semester: 5
Teaching unit: UEM 3.1
Subject 3: Power Electronics Lab
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:
To complete, consolidate, and verify the knowledge already acquired in the course.

Recommended prerequisite knowledge:
Basic electrical and electronic circuits.

Subject content:
Lab 1: Switching component (IGBT, MOS).

Lab 2: Uncontrolled single-phase and three-phase rectifier (load R, L).

Lab 3: Controlled single-phase and three-phase rectifier (load R, L).

Lab 4: Chopper.

Lab 5: Single-phase inverter.

Lab 6: Single-phase phase-angle control (load R, L).

Lab 7: Three-phase phase-angle control.

Evaluation method:
Continuous assessment: 100%.

Bibliographic references:

Semester: 5
Teaching unit: UEM 3.1
Subject 4: Feedback Control Systems Lab/ Sensors Lab
VHS: 22h30 (Lab: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:
To complement, consolidate, and verify the knowledge already acquired in the feedback control systems and sensors and metrology courses.

Recommended prerequisites:
Feedback control systems.

Content of the subject:

Lab 1: Study of behaviors of 1st, 2nd, and 3rd order systems
Analog and computer simulations, Measuring parameters that characterize different responses: rise time, settling time, maximum overshoot, peak time, and accuracy, Observing the response of an unstable system.

Lab 2: Frequency responses and system identification
Determining the frequency characteristics of a control system in order to identify the transfer function of a system, 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 the behavior of the system.

Lab 4: Speed control of a DC motor
The operation of elements and the closed-loop control system, The influence of gain on the stability of the system, 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 feedback control systems
Analog and computer simulations. Studying the stability and accuracy of feedback control systems by modifying their parameters (Resistance, Capacitance, Inductance, etc.) and their architectures (series, parallel). Application of the algebraic criterion of Routh-Hurwitz, criteria in the Nyquist and Bode plots. Measuring the stability margin, calculating static and dynamic errors as well as accuracy for different types of systems (presence of integrators, differentiators, etc.) and for different types of inputs (step, ramp, impulse).

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

Assessment mode:
Continuous assessment: 100%.

Bibliographical references:

Semester: 5
Teaching Unit: UED 3.1
Subject 1: Sensors and Metrology
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:
To know the different components of a measuring chain: The principle of operation of a sensor, the metrological characteristics, the appropriate conditioner, and the basic knowledge concerning the data acquisition chain.
Recommended Prerequisite Knowledge:
Electrical and electronic measurements, Basic electronics.
Content of the Subject:
Chapter 1. Generalities (2 weeks)
The components of a measuring chain, sensors (passive, active), conditioning circuits (divider, bridges, amplifiers, and instrumentation amplifier). 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. Deformation, force, and pressure sensors (2 weeks)

Chapter 6. Rotational speed sensors (2 weeks)
Analog, digital tachometer.

Chapter 7. Flow, level, and humidity sensors (2 weeks)

Chapter 8. Data acquisition chain (1 week)

Evaluation Method:
Exam: 100%.

Bibliographic References:

1. Georges Asch et Collaborateurs, "Les capteurs en instrumentation industrielle", 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, "Instrumentation industrielle: Spécification et installation des capteurs et des vannes de régulation", 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
Teaching Unit: UED 3.1
Subject 2: Electrical Systems Design
VHS: 22h30 (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
To be able to calculate and dimension an electrical machine according to the requirements of a specific specification.

Recommended prerequisites:
Constituent elements and operating principles of electrical machines.

Subject 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
Dimensioning of a single-phase transformer, choice of active material (magnetic circuit, conductive and insulating materials, mechanical components).

Chapter 3 - Direct current machines (3 weeks)
Review of the operating principle and their uses
Dimensioning of the machine, choice of winding, nameplates.

Chapter 4 - Asynchronous machines (3 weeks)
Review of the operating principle and their uses
Dimensioning of an asynchronous machine, choice of winding, choice and selection of asynchronous motors.

Chapter 5 - Synchronous machines (3 weeks)
Review of the operating principle and their uses
Dimensioning of a synchronous machine, choice of winding.

Bibliographic references:

1. http://elearning.vtu.ac.in/06EE63.html
2. *Transformers desing, A. Dymkov, Mir Bublishers, Moscow, 1975*
3. *Calcul des machines électriques. Tome I et Tome II / M. Liwschitz Dunod / cop. 1967-1970*
4. *Conception des moteurs asynchrone triphasés, BOUCHARD & OLIVIER, Ecole ploytechnique de Montréal, 1997*
5. *Design of Rotating Electrical Machines, 2nd Edition, JuhaPyrhonen, TapaniJokinen, Valeria Hrabovcova, ISBN: 978-1-118-70165-2, Sep 2013, 616 pages*
6. *Théorie industrielle de l''électricité et des machines électriques, par A. Verdurand,...1919*
7. ***La construction des machines électriques, Julien Dalemont, Librairie polytechnique, 1907 - 138 pages***

Semester: 5
Teaching Unit: UET 3.1
Subject 1: Simulation software
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:
To know simulation software, and be able to reproduce an electro-energetic system for study and simulation purposes.

Recommended prerequisites:
Programming concepts, Matlab knowledge.

Subject Content:
Chapter 1: Introduction to MATLAB (2 weeks)
1.1 - Introduction
1.2 - MATLAB environment
1.3 - Starting MATLAB
Command window, Workspace window (defined variables space), Working directory window, Command history window
1.4 - Presentation and generalities
Getting help, First steps, Workspace, Syntax of an instruction line, Managing files in the working directory, Arithmetic operations, Operations and functions on scalars, 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, Character strings, Vectors, Matrices, Polynomials.

Chapter 3: Graphs (1 week)
3.1 - Graphical window management
3.2 - 2D graphical representation
Graphs in Cartesian coordinates, Improving the readability of a figure, Graphs in polar coordinates, Diagrams.
3.3 - 3D graphs
3D curves, Surfaces

Chapter 4: Programming with MATLAB (2 weeks)
4.1 - Arithmetic, logical and special character operators
4.2 - M-Files
4.3 - Scripts and functions
(Scripts, Functions)
4.4 - Control instructions
(FOR loop, WHILE loop, IF conditional statement)

Chapter 5: Introduction to SIMULINK (3 weeks)
5.1 - SIMULINK libraries

Source Libraries, Sinks Libraries, Continuous Libraries, Math Operations Libraries, Commonly Used Blocks Libraries, Signal Routing Libraries, Logic and Bit Operations Libraries, User-Defined Functions Libraries, Ports & Subsystems Libraries, ….
5.2 - Quick start
5.3 - Masks and subsystems
5.2.1 - Subsystems
5.3.2 - Subsystem masking
Masking of the subsystem, Use of Callbacks
5.4 - Study of some simulation examples

Chapter 6: Power System Blockset (PSB) (2 weeks)
6.1 - Presentation of the Power System Blockset
6.2 - Study of a simulation example

Chapter 7: Simulation and co-simulation with other software (3 weeks)
7.1 - Simulation with PSim and co-simulation Simulink-PSim
7.2 - Simulation with other software: PSpice, Proteus, Scilab,….

Assessment method:
Exam: 100%.

Bibliographic references:

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

Semester: 6
Teaching Unit: UEF 3.2.1
Subject 1: Control of Electric Machines
VHS: 67h30 (Lectures: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives:
To understand, analyze, and model the machine-converter system, to perform wiring of control and power circuits of electric machines.

Recommended Prerequisites:
Electric Machines, Static Converter, Control Systems, Open-loop and Closed-loop Control.

Course Contents:
Chapter 1. Introduction to control of electric machines (1 week)

Chapter 2. Control of static converters (1 week)
PWM technique

Chapter 3. Speed control of DC machines (5 weeks)
Review of DC machines (working principle, equivalent electrical circuit, different types of DC machines), Electromechanical and mechanical characteristics of DC machines, Mechanical characteristics of the driven loads, Operating point of a motor group, driven load (Stability, Starting, Electric braking).
Methods of speed control of a shunt motor (rheostatic control, flux control, voltage control).

Chapter 4. Speed variation of asynchronous motors (4 weeks)
Review of asynchronous machines, Review of power electronics converters, Association of asynchronous machines (converters), Speed control of asynchronous motors (control by action on the supply voltage, control by action on the rotor resistance, cascade hypo-synchronous control, control by varying the supply frequency).

Chapter 5. Speed control and autopilot of synchronous motors (4 weeks)
Review of synchronous machines, Association of synchronous machines (converters), Speed control of synchronous motors (principle of autopilot of synchronous motors, speed control of the autopiloted synchronous machine powered by a current switch, speed control of the autopiloted synchronous machine powered by a PWM voltage inverter).

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

Bibliographic References:

1. R. Abdessemed, "Modélisation et simulation des machines électriques", Ellipses, Collection ,2011.
2. M. Juferles, "Entraînements électriques: Méthodologie de conception", Hermès, Lavoisier, 2010.
3. G. Guihéneuf, "Les moteurs électriques expliqués aux électroniciens, Réalisations : démarrage, variation de vitesse, freinage", Publitronic, Elektor,2014.
4. P. Mayé, "Moteurs électriques industriels, Licence, Master, écoles d'ingénieurs", Dunod, Collection:Sciences sup, 2011.
5. S. Smigel,"Modélisation et commande des moteurs triphasés. Commande vectorielle des moteurs synchrones", 2000.
6. J. Bonal, G. Séguier, "Entrainements électriques à vitesses variables". Vol. 2, Vol. 3

Semester: 6
Teaching unit: UEF 3.2.1
Subject 2: Industrial Regulation
VHS: 45 hours (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient: 2
Teaching objectives:
To master the principle and structure of control loops. To choose the appropriate regulator for an industrial process in order to achieve the required performance (stability, accuracy).

Recommended prerequisites:
Knowledge of continuous linear control and general electricity.

Course content:
Chapter 1. Introduction to industrial regulation (2 weeks)
Concepts of industrial processes, Elements of a control loop (industrial process, actuators, sensors, regulators, signal conditioners, set point, measurement, disturbance, characteristic variables, control variables, controlled variables, perturbing variables), Diagram of a controlled system, Constituents of a control loop, symbols, functional diagrams and loops, performance criteria of a control.

Chapter 2. On-off regulator (2 weeks)
On-off regulator, On-off regulator with threshold, On-off regulator with hysteresis, On-off regulator with threshold and hysteresis.

Chapter 3. Identification of open-loop and closed-loop systems (2 weeks)
Purpose of identification, Model selection, Open-loop identification (S-curves, integrator curves, oscillatory curves), Closed-loop identification (methods of oscillation).

Chapter 4. Standard regulators: P, PI, PD, PID (2 weeks)
Characteristics, Structures of PID regulators (parallel, series, mixed), Electronic and pneumatic implementations.

Chapter 5. Selection and sizing of regulators (4 weeks)
Selection criteria, Sizing methods (flat criterion, symmetrical criterion, Ziegler Nichols method, etc.), Regulator tuning by imposing a tracking model.

Chapter 6. Industrial applications (3 weeks)
Temperature, flow, pressure, level control.
Assessment method:
Continuous assessment: 40%; Examination: 60%.
Bibliographic References:

1. E. Dieulesaint, D. Royer, "Automatique appliquée", 2001.
2. P. De Larminat, "Automatique: Commande des systèmes linéaires. 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, "La régulation industrielle", Editions,Hermes, 1995.
6. P. Borne, "Analyse et régulation des processus industriels tome 1: Régulation continue". Editions Technip.
7. T. Hans, P. Guyenot, "Régulation et asservissement" Editions,Eyrolles.
8. R. Longchamp,"Commande numérique de systèmes dynamiques cours d'automatique", 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
Subject 1: Industrial Automation
VHS: 45 hours (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives:
Master graphical representation tools for automated systems (Grafcet), Install and maintain industrial automation elements, Perform programming and configuration of programmable logic controllers (PLCs).

Recommended prerequisites:
Basic knowledge of digital electronics, Programming languages.

Subject content:
Chapter 1. Introduction to automated systems (3 weeks)
Global function of a system, Automation and structure of automated systems, Pre-actuators (Contactors, Triac, ...), Actuators (cylinders, Motors, ...), Sensors, Classification of automated systems, Specification of levels of the specification sheet, Representation tools for functional specifications.

Chapter 2. Grafcet (3 weeks)
Definition and basic concepts, Establishment rules for Grafcet, Transitions and directed links, 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 the elements of a PLC, Choice of processing unit, Choice of an industrial programmable logic controller, Input-output interfaces, Graphic and textual programming tools, Implementation of an industrial programmable logic controller, Principles of automation networks.

Chapter 4. Guide to the Study of Start and Stop Modes (G.E.M.M.A) (3 weeks)
Concept and structuring of GEMMA, Operating procedures, stop procedures and fault procedures, Practical use of GEMMA and applications.

Chapter 5. Electrotechnical Applications (2 weeks)
Automation of starting DC motors, Automatic start-stop of asynchronous and synchronous motors, Automation of the electromagnetic protection process of electric motors, Automation of motor protections by thermal relays.

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

Bibliographic references:

1. Jean-Claude Humblot, "Automates programmables industriels", Hermès, 1993.
2. Sandre Serge, Jacquar Patrick, "Automates programmables industriels", Lavoisier, 1993.
3. P. Le Brun, "Automates programmables", 1999.
4. Jean-Yves Fabert, "Automatismes et Automatique", Ellipses, 2005.
5. William Bolton, "Les Automates Programmables Industriels", Dunod, 2009.

6. KhushdeepGoyal and Deepak Bhandari, "Industrial Automation and Robotics", Katson Books, 2008.
7. Gérard Boujat, Patrick Anaya, "Automatique industriel en 20 fiches, Dunod, 2013.
8. Simon Moreno, Edmond Peulot, "Le Grafcet: Conception-Implantation dans les automates programmables industriels", Edition Casteilla 2009.
9. G. Michel, "Les API:Architecture et applications des automates programmables industriels", Edition Dunod, 1988.
10. William Bolton, "Les Automates Programmables Industriels", Edition Dunod, 2010.
11. Frederic P. Miller, Agnes F. Vandome, John McBrewster, "Automates Programmables Industriels: Programmation informatique, Automatique, Industrie, Programmation (informatique), Interrupteur, Automaticien", Edition AlphascriptPublishing, 2010.

Semester: 6
Teaching unit: UEF 3.2.2
Subject 2: Materials and Introduction to High Voltage
VHS: 45 hours (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objectives:
To choose the appropriate material based on its operating conditions and environment.

Recommended prerequisites:
Material composition, theory of electric field and disruptive electric discharge.

Subject content:
Part I - Electro-technical materials
Chapter 1. Conductive materials (1 week)
Basic concepts, Classification of conductive materials and their properties according to their use.

Chapter 2. Magnetic materials (3 weeks)
Magnetism at the microscopic and macroscopic levels, 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, Energy concepts 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 losses, Physico-mechanical properties, Electro-insulating materials.

Chapter 4. Semiconductor materials: (1 week)
Overview of semiconductors and their applications.

Chapter 5. Superconducting materials (1 week)
Overview of superconductors and their applications.

Part II - Introduction to High Voltage
Chapter 1. Overview of high voltage (1 week)
Voltage ranges, Utility of high voltage, Selection of high voltage equipment, Technological and industrial applications of high voltage.

Chapter 2. Overview of constraints due to high voltage (2 weeks)
Objectives and methodology of high voltage, Voltage-related constraints, Current-related constraints, Protection against overvoltage and overcurrent.

Chapter 3. High voltage measurement (2 weeks)
Sources of high voltage, Measurement of high voltages.

Chapter 4. Transient phenomena in high voltage (2 weeks)

Causes of overvoltage, Lightning phenomena and their impact on electrical installations, Switching overvoltages, Different protection techniques.

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

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

Semester: 6
Teaching unit: UEM 3.2
Subject 1: End-of-cycle project
VHS: 45h00 (TP: 3h00)
Credits: 4
Coefficient: 2

Teaching objectives:
To assimilate, in a global and complementary way, the knowledge acquired in different subjects. To put into concrete practice the concepts taught during the training. To encourage autonomy and initiative in the student. To teach them how to work collaboratively within a framework that fosters intellectual curiosity.

Recommended prerequisites:
The entire Bachelor's degree program.

Subject content:
The theme of the End-of-Cycle Project must be chosen in consultation between the supervising teacher and a student (or a group of students: a pair or a trio). The topic must necessarily be related to the objectives of the training and the student's actual abilities (at the Bachelor's level). It is also preferable that the theme takes into account the social and economic environment of the institution. When the nature of the project requires it, it may be subdivided into several parts.

Remarks:
During the weeks when students are familiarizing themselves with the purpose of their project and its feasibility (bibliographic research, search for necessary software or hardware for the project, revision and consolidation of teaching that is directly related to the subject, etc.), the subject teacher should take advantage of this time to remind students of the essential content of the two subjects "Writing Methodology" and "Presentation Methodology" covered during the first two semesters of the common core.

At the end of this study, the student must submit a written report in which they must explain, in the most explicit way possible:

A detailed presentation of the study topic, emphasizing its interest in its socio-economic environment.
The means used: methodological tools, bibliographic references, contacts with professionals, etc.
The analysis of the results obtained and their comparison with the initial objectives.
The critique of the discrepancies observed and the possible presentation of additional details.
Identification of difficulties encountered, highlighting the limits of the work done and the follow-up required for the work completed.
Finally, the student or group of students present their work (in the form of a brief oral presentation or on a poster) to their supervising teacher and an examining teacher who may ask questions and evaluate the work done both technically and in terms of presentation.

Assessment method:
Continuous assessment: 100%.

Semester: 6
Teaching Unit: UEM 3.2
Subject 2: Machine Control Lab
VHS: 15h00 (Lab: 1h00)
Credits: 1
Coefficient: 1

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

Recommended Prerequisites:
Basic principles of Electrical Engineering and knowledge of electric machine characteristics.

Course Content:
Lab 1: Starting a DC motor
Lab 2: Bidirectional rectifier association / DC machine
Lab 3: Chopper association / DC machine
Lab 4: Inverter association / AC machine
Lab 5: Frequency converter association / AC machine
Lab 6: Study of stepper motor control

Assessment Method:
Continuous assessment: 100%.

Bibliographical References:
Notes de cours sur les machines électriques, électronique de puissance et la commande.

Semester: 6
Teaching Unit: UEM 3.2
Subject 3: Industrial Regulation TP
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:
Manipulate control loops, compare practical and theoretical parameters.

Recommended prerequisites:
Controlled systems and regulation courses.

Subject content:
TP1: Frequency responses and system identification.
TP2: Regulator characteristics.
TP3: Analog regulation (PID) of fluid level.
TP4: Speed regulation of an MCC motor.
TP5: Pressure regulation.
TP6: Temperature regulation.

Evaluation mode:
Continuous assessment: 100%

Bibliographical references
Brochure de TP, Notes de cours, Documentation de Labo.

Semester: 6
Teaching unit: UEM 3.2
Subject 4: Automation Lab/ Materials and High Voltage Lab
VHS: 22.5 hours (Lab: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:
To conduct experiments to enhance knowledge on industrial automation. To be able to select and characterize an unknown material.

Recommended prerequisites:
Course content.

Subject content:
Automation Lab
Lab 1: Introduction to Grafcet or other automation language (1 week)
Lab 2: Getting started with automation software, e.g. Automgen or other software (1 week)
Lab 3: Convergence and divergence in AND and OR (2 weeks)
Lab 4: Timing (1 week)
Lab 5: Counters (1 week)
Lab 6: Grafcet of an automatic drilling post (1 week)
Lab 7: Grafcet of a bottle filling system (1 week)
Lab 8: Grafcet of a direct start of a three-phase motor in two directions of rotation (2 weeks)

Materials and High Voltage Lab
Measurement of the transverse dielectric rigidity of a gas, solid, and liquid. Characterization of the longitudinal dielectric rigidity of an insulation based on its surface state (clean or polluted). Measurement of the surface, volume, and insulation resistance of an insulator. Determination of the relative permittivity, capacity, and dielectric losses of a solid and liquid insulation.

Evaluation mode:
Continuous assessment: 100%.

Bibliographical references:
Notes de cours et Brochures du labo.

Semester: 6
Teaching unit: UED 3.2
Subject 1: Electrical Network Protection
VHS: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
To become familiar with the different processes and techniques for protecting electrical networks and their components against various constraints and to ensure better protection.

Recommended prerequisite knowledge:
Fundamental notions of electricity, Equivalent diagrams of electrical circuits, Electrical power networks (constitution, modeling, and calculation).

Subject content:
Chapter 1. Introduction to Protection (4 weeks)
General notions about the main faults that may occur in an electrical power network, Measuring devices and reduction of electrical parameters characterizing the different faults (current transformer, potential transformer, impedance measurement, power measurement, symmetrical current and voltage component filters, etc.), Generalities on protection (Definitions; Selectivity; Sensitivity; Speed and reliability), Ampere and volumetric protections, Selectivity mode.

Chapter 2: Review of symmetrical components and fault currents (3 weeks)
Definition of symmetrical components, Transformation of the impedances of loads into symmetrical components, Symmetrical components of "series" impedances, Equivalent single-phase diagrams of the sequences of rotating machines, Expression of apparent power in symmetrical components, equivalent diagrams (direct, inverse, and homopolar, relations of different types of faults).

Chapter 3. Elements of the Protection System (3 weeks)
Structural principle model, Technology - operation and applications of different types of relays (current relays, voltage relays, differential current relays, directional power relays, distance relays, etc.), Voltage and current transformation.

Chapter 4. Protection of Network Components (5 weeks)
Protection of alternators and motors, Protection of busbars, Protection of transformers, Protection of lines, distance, and differential protection.

Evaluation mode:
Exam: 100%

Bibliographic references:

1. HadiSaadat, "Power system analysis", Edition 2, 2004.
2. Furan Gonon, "Electric Power distribution system engineering", Edition, 1980.
3. Christophe Prévé, "Protection des réseaux électriques", Hermes Paris, 1998.
4. S. H. Horowitz, A. G. Phadke, "Power System Relaying", second edition, John Wiley & Sons, 1995.
5. L. Féchant," Appareillage électrique à BT, Appareils de distribution", Techniques de l'Ingénieur, traité Génie électrique, D 4 865.
6. S. Vacquié, A. Lefort, "Étude physique de l'arc électrique, L'arc électrique et ses applications", Tome 1, éd. du CNR,S 1984.

Semester: 6
Teaching Unit: TU 3.2
Subject 2: Industrial Maintenance
Total Hours: 22.5 (Lecture: 1.5 hours)
Credits: 1
Coefficient: 1
Teaching Objectives:
Ensure the continuity of service of an industrial installation, identify the functions and components of electrical and electronic equipment, determine the causes of system failures and repair them.

Recommended Prerequisites:
Statistics, devices, measurements, and instrumentation.
Course Content:
Chapter 1. Generalities on maintenance (4 Weeks)
History (concepts and standardized terminology, ...), Role of maintenance and troubleshooting of equipment in the industry, Elements of applied mathematics in maintenance, Behavior of equipment in service, Failure rate 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. Organization and management of maintenance (4 Weeks)
Structure of specialized workshops for troubleshooting electromechanical converters, Organization of maintenance operations, Main steps in the technology of troubleshooting electrical machines, Study of different breakdowns of electrical machines and methods of detection, Dismantling and reassembly techniques, Testing and diagnostics before troubleshooting.

Chapter 3. Troubleshooting of different parts of electrical machines (4 Weeks)
Troubleshooting of the mechanical part, Troubleshooting of the electrical part, Calculation and verification of parameters of electro-energetic systems, Recalculation of electro-energetic systems with other data from the nameplate, Assembly work and testing method after troubleshooting.

Chapter 4. Generalities on computer-aided maintenance (CAM) (3 Weeks)

Assessment Method:
Exam: 100%

Bibliographical References:

1. G. Zwingelstein, "Diagnostic de défaillance", Hermès, Paris, 1997.
2. "La maintenance basée sur la fiabilité", Hermès, Paris, 1997.
3. Jean Henq, "Pratique de la maintenance préventive", Dunod, 2000.
4. Raymond Magnan, "Pratique de la maintenance industrielle", Dunod, 2003.
5. Yves Lavina, "Maintenance industrielle, Fonction de l'entreprise", 2005.
6. M. François, "Maintenance: méthode et organisation", Dunod, Paris, 2000.
7. M. François, "Maintenance: méthode et organisation", Dunod, Paris, 2000.
8. A. Boulenger, C. Pachaud, "Diagnostic vibratoire en maintenance préventive", Dunod, Paris, 2000.
9. Jean Henq, "Pratique de la maintenance préventive", Dunod,, Paris, 2002.
10. R. Cuigent, "Management de la maintenance", Dunod, Paris, 2002.
11. Rachid Chaib, "La maintenance et la sécurité industrielle dans l'entreprise", Dar El Houda,, Alger, 2007.
12. S. Robert, S. Stéphane, "Maintenance: la méthode MAXER", Dunod, Paris, 2008.
13. J. F. D. Beaufort, "Emploi des relais pour la protection des installations", 1972.
14. Michel Pierre Villoz, "Protection et environnement", Technique et ingénieur, 2006.
15. Nichon Margossian, "Risques professionnelle", Technique et ingénieur, 2006.

Semester: 6
Teaching Unit: UET 3.2
Subject: Entrepreneurship and Business Management
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

- Prepare students for professional integration after graduation;
- Develop entrepreneurial skills among students;
- Raise awareness among students and familiarize them with the possibilities, challenges, procedures, characteristics, attitudes, and skills required for entrepreneurship;
- Prepare students to create their own company someday or at least better understand their work in a small or medium-sized enterprise (SME).

Recommended prerequisites:

No specific knowledge, except for proficiency in the language of instruction.

Skills targeted:

Ability to analyze, synthesize, work in a team, communicate effectively orally and in writing, be autonomous, plan and respect deadlines, be reactive and proactive. Raise awareness of entrepreneurship through an overview of management knowledge useful for creating activities.

Content of the subject:

Chapter 1 – Operational preparation for employment: (2 weeks)
Writing a cover letter and CV, job interviews, documentary research on the careers in the field, conducting interviews with professionals in the field, and simulating job interviews.

Chapter 2 - Entrepreneurship and entrepreneurial spirit: (2 weeks)
Entrepreneurship, companies around you, entrepreneurial motivation, setting objectives, taking risks.

Chapter 3 - Entrepreneur profile and entrepreneurship career: (3 weeks)
Qualities of an entrepreneur, negotiation skills, listening skills, the role of SMEs and micro-enterprises in Algeria, the main success factors when creating an SME/micro-enterprise.

Chapter 4 - Finding a good business idea: (2 weeks)
Creativity and innovation, recognizing and evaluating business opportunities.

Chapter 5 - Launching and operating a company: (3 weeks)
Choosing a suitable market, choosing the location of the company, legal forms of the company, seeking help and funding to start a company, recruiting staff, choosing suppliers.

Chapter 6 - Development of the business plan: (3 weeks)

The Business Model and the Business Plan, implementing the Business Model Canvas for the business project.

Assessment method: Exam: 100%

References:

- FayolleAlain, 2017. Entrepreneuriat théories et pratiques, applications pour apprendre à entreprendre.Dunod, 3e éd.

- LégerJarniou, Catherine, 2013, Le grand livre de l'entrepreneur. Dunod, 2013.

- PlaneJean-Michel, 2016, Management des organisations théories, concepts, performances. Dunod, 4ème éd.

- LégerJarniou, Catherine, 2017, Construire son Business Plan. Le grand livre de l'entrepreneur. Dunod,.

- Sion Michel, 2016, Réussir son business Méthodes, outils et astuces plan.Dunod ,4èmeéd.

- Patrick Koenblit, Carole Nicolas, Hélène Lehongre, Construire son projet professionnel, ESF, Editeur 2011.

- Lucie Beauchesne, Anne Riberolles, Bâtir son projet professionnel, L'Etudiant 2002.

- ALBAGLI Claude et HENAULT Georges (1996), La création d'entreprise en Afrique, ed EDICEF/AUPELF ,208 p.