الجمهورية الجزائرية الديمقراطية الشعبية
République Algérienne Démocratique et Populaire
وزارة التعليم العالي والبحث العلمي
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique

Université

Logo

TRAINING OFFER
L.M.D.

ACADEMIC LICENSE

NATIONAL PROGRAM
2021 – 2022
(2nd update)

Establishment	Faculty / Institute	Department

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

CPNDST

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اللجنة البيداغوجية الوطنية
لميدان العلوم و التكنولوجيا

Comité Pédagogique National du Domaine Sciences et Technologies

عرض تكوين
ل. م . د

ليسانس أكاديمية

برنامج وطني
2022 – 2021

المؤسسة	الكلية/ المعهد	القسم

الميدان	الفرع	التخصص
علوم و تكنولوجيا	كهروتقني	كهروتقني

Summary

I – License identity form

1 - Location of training :

Faculty (or Institute) :

Department :

References of the license authorization order (attach a copy of the order)

2- External partners :

Other partner establishments :

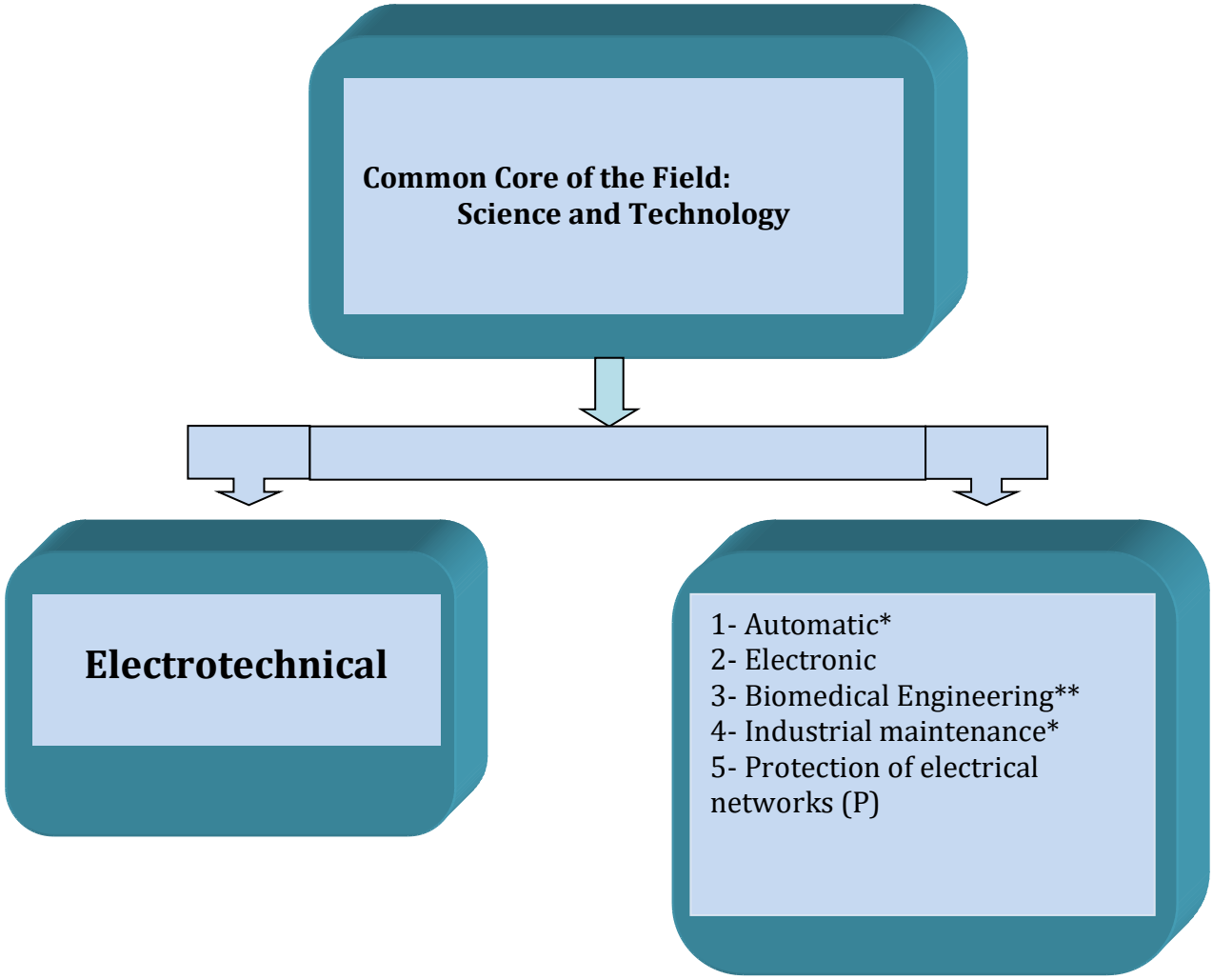
Businesses and other socio-economic partners :

International partners :

3 – Context and objectives of the training

A – General organization of training: position of the project

Enter in the following diagram the License that is the subject of this framework as well as all the approved licenses (functional or not) at the establishment level and belonging to the same Group of sectors. Specify with an asterisk any other license whose supervision is also provided by a large part of the teachers involved in this current license. Indicate with a double asterisk the frozen licenses. Also mark with (P) any professional type license.



B - Training objectives:

Electrical energy is central to the economic development of any country. It is inescapably vital to the functioning of all the mechanisms that govern various social dynamics. As such, electrical engineering, in all its segments (production, transmission, distribution, conversion, and control), has occupied a key position in the industrial sector of these countries and continues to be the subject of special attention, scientific investment, and ongoing technological improvement. Electrical engineering continues to develop thanks to advances in power electronics, microprocessors, and programmable logic controllers.
Furthermore, the optimization of electrotechnical systems and the improvement of their performance constitutes a promising challenge for the sector thanks to the application of sustainable development concepts by reducing their weight and using recyclable materials.
All of these major technological developments in recent years have increased the need for skills in the electrical engineering field among industrial companies. Investing in training and preparing managers to meet these challenges is becoming essential. This training is offered with this objective in mind.

The program is structured into six semesters, the first two of which (Common Core) are for all students in the Science and Technology field. The third semester is a pre-specialization and brings together all students in the Electrical Engineering program. From semester four onward, the courses become specialized and are primarily focused on electrical engineering.

This license, due to its general nature, offers a balanced education in the four axes of the field of electrical engineering, namely: electrical machines, electrical networks, automation and power electronics. It is motivated by the fact that nowadays, the four options of electrical engineering are very closely linked (an electrical machine is often used with a static converter and the control circuit).

C – Targeted profiles and skills:

The main objective of this training is to enable students to acquire a dual qualification. Thus, holders of this Bachelor's degree will have acquired, upon completion of this course, the skills necessary to integrate a professional environment in the production, transmission, distribution, or exploitation of electrical energy. They can also, through the theoretical lessons acquired, continue their studies in one of the many existing Master's degrees.

Thus, the Electrotechnical License gives the student good adaptability skills that will enable him to assert himself in new situations during his career. In this respect, he is able to:

- ✓ Understand the physical phenomena linked to the transformations and use of electrical energy.
- ✓ Define and operate electrical power equipment and associated control systems to produce energy or operate automation systems.
- ✓ Know the different components of electrical networks and become familiar with the means of control and protection.
- ✓ define the distribution, protection and control equipment, from high voltage to low voltage and their commissioning.
- ✓ Understand the real specificities of electrical networks and the means to be implemented for the stability of these networks.

- ✓ Adapting to the new technological specificities of businesses.

D – Regional and national employability potential :

All industries today operate using electrical energy and use electrical machines. It is therefore clear that employment opportunities for holders of this degree throughout the country are guaranteed, on the one hand. Furthermore, and given national guidelines for the development of strategic sectors (desalination of seawater, electricity production and renewable energies), private and/or public investors will certainly begin to exploit, in the near future, modern means of electricity production, which therefore portends a promising future for graduates of this sector.

Generally speaking, the energy sector remains promising in terms of opportunities in various fields: oil and gas industries, refrigeration, air conditioning, food processing, transport, chemical industries, hydraulics, heavy industries, etc.

E – Bridges to other specialties :

Semesters 1 and 2 common	
Sector	**Specialties**
Aeronautics	Aeronautic
Civil engineering	Civil engineering
Climate engineering	Climate engineering
Maritime engineering	Naval Propulsion and Hydrodynamics
	Naval construction and architecture
Mechanical Engineering	Energy
	Mechanical construction
	Materials Engineering
Hydraulic	Hydraulic
Transportation Engineering	Transportation Engineering
Metallurgy	Metallurgy
Optics and precision mechanics	Optics and photonics
	Precision mechanics
Public works	Public works
Automatic	Automatic
Electromecanical	Electromecanical
	Industrial maintenance
Electronic	Electronic
Electrotechnical	Electrotechnical
Biomedical Engineering	Biomedical Engineering
Industrial engineering	Industrial engineering
Telecommunication	Telecommunication
Process engineering	Process engineering
Mining engineering	Mining
	Valorization of mineral resources
Hydrocarbons	Hydrocarbons
Industrial hygiene and safety	Industrial hygiene and safety
Petrochemical industries	Refining and petrochemicals

Table of sectors and specialties in the Science and Technology field

Sector group A	Common semester 3
Sector	**Specialties**
Automatic	Automatic
Electromecanical	Electromecanical
	Maintenance industrielle
Electronic	Electronic
Electrotechnical	Electrotechnical
Biomedical Engineering	Biomedical Engineering
Industrial engineering	Industrial engineering
Telecommunication	Telecommunication

Sector group B	Common semester 3
Sector	**Specialties**
Aeronautics	Aeronautics
Civil engineering	Civil engineering
Climate engineering	Climate engineering
Maritime engineering	Naval Propulsion and Hydrodynamics
	Naval construction and architecture
Mechanical Engineering	Energy
	Mechanical construction
	Materials Engineering
Hydraulic	Hydraulic
Transportation Engineering	Transportation Engineering
Metallurgy	Metallurgy
Optics and precision mechanics	Optics and photonics
	Precision mechanics
Public works	Public works

Sector group C	Common semester 3
Sector	**Specialties**
Process engineering	Process engineering
Mining engineering	Mining
	Valorization of mineral resources
Hydrocarbons	Hydrocarbons
Industrial hygiene and safety	Industrial hygiene and safety
Petrochemical industries	Refining and petrochemicals

The courses which present common basic teachings between them (semester 3) have been grouped into 3 groups: A, B and C. These groups correspond schematically to the families of Electrical Engineering (Group A), Mechanical Engineering and Civil Engineering (Group B) and finally Process Engineering and Mining Engineering (Group C).

This license offers multidisciplinary and cross-disciplinary teaching programs:

Multidisciplinary, in the sense that the courses in this specialty are 100% identical for semesters 1 and 2 with all the specialties in the Science and Technology field. On the other hand, the courses in semester 3 for all the specialties in the same group of sectors are also 100% identical.

Semester	Sector group	Common lessons
Semester 1	A - B - C	(30 / 30) Credits
Semester 2	A - B - C	(30 / 30) Credits
Semester 3	A - B	(18 / 30) Credits
	A - C	(18 / 30) Credits
	B - C	(24 / 30) Credits

In a transversal manner, this Licence offers the student the choice of joining, if he expresses the desire and depending on the teaching places available:

- All other specialties in the ST field at the end of semester 2.

- All specialties in the same group of courses at the end of semester 3.

- All specialties from another program group at the end of semester 3
(Subject to equivalence and approval by the training team).

- All specialties within the same program group at the end of semester 4
(Subject to equivalence and approval by the training team).

F – Expected performance indicators of the training :

All training must meet the quality requirements of today and tomorrow. As such, to better assess the expected performance of the training offered on the one hand and by exploiting the flexibility and adaptability of the LMD system on the other hand, a number of mechanisms are proposed, for information purposes, for this degree to evaluate and monitor the progress of teaching, the training programs, student/teacher and student/administration relationships, the future of graduates of this degree as well as the assessments of the university's partners regarding the quality of the graduates recruited and/or the teaching provided. It is up to the training team to enrich this list with other criteria according to its own means and objectives.

The evaluation methods can be implemented through surveys, on-site monitoring of students in training, and surveys of recruited graduates and their employers. To achieve this, a report must be prepared, archived, and widely disseminated.

1. Evaluation of the training progress :

In addition to the regular meetings of the teaching committee, a meeting is held at the end of each semester. It brings together teachers and students from the class to discuss any problems encountered, possible improvements to teaching methods in particular, and the quality of training in general.

To this end, a more or less exhaustive list of indicators and methods envisaged for the evaluation and monitoring of this training project by the educational committee is proposed below :

Before training :

- ✓ Evolution of the rate of students having chosen this Degree (Supply/demand ratio).
- ✓ Rate and quality of students who choose this degree.

During training :

- ✓ Regularity of academic committee meetings. Alignment of end-of-cycle project themes with the nature of the program.
- ✓ Quality of the relationship between students and the administration.
- ✓ Support provided to students experiencing difficulties.
- ✓ Student satisfaction rate with teaching and teaching methods.

Downstream of training :

- ✓ Student success rate per semester for this degree.
- ✓ Student dropout rate (failures and withdrawals).
- ✓ Identification of the causes of student failure.
- ✓ Redirection alternatives are offered to students who fail.
- ✓ Percentage of students who graduate on time.
- ✓ Percentage of students who continue their studies after completing their degree.

2. Evaluation of the progress of the lessons :

The teaching in this course is subject to regular evaluation (once a year) by the training team which will be made available, upon request, to the various institutions: National Educational Committee for the Field of Sciences and Technologies, Regional Conferences, Vice-rectorate responsible for education, Faculty, etc.

Therefore, a system for evaluating programs and teaching methods can be established based on the following indicators:

- ✓ Equipping classrooms and teaching laboratories with the materials and supports needed to improve teaching (projection systems (data shows), Wi-Fi connection, etc.).
- ✓ Existence of a communication and teaching platform where lectures, tutorials, and practical work are accessible to students and their questions are addressed.
- ✓ Equipping teaching laboratories with materials and equipment appropriate to the teaching content.
- ✓ Number of actual teaching weeks provided during a semester. Program completion rate.

- ✓ Digitization and preservation of final dissertations and/or final year dissertations.
- ✓ Number of practical exercises completed and the number of practical exercises per subject (diversity of practical exercises).
- ✓ Quality of the institution's documentary collection related to the specialty and its accessibility.
- ✓ Support from the socio-economic sector for training (company visits, internships, seminars taught by professionals, etc.).

3. Graduate integration :

A coordination committee, composed of training managers and members of the Administration, is hereby established. Its primary responsibilities are: monitoring the professional integration of graduates from the program, creating a graduate tracking database, identifying and/or updating existing economic and industrial opportunities at the regional and national levels, anticipating and developing new careers related to the program in association with the Chamber of Commerce, various employment support agencies, public and private operators, etc., and participating in any action related to the professional integration of graduates (organizing events with socio-economic stakeholders).
To carry out these missions, this committee has the discretion to conduct or commission any study or survey on the employment and post-employment outcomes of graduates. Below is a list of indicators and methods that could be considered for evaluating and monitoring this operation:

- ✓ Graduate recruitment rates in the socio-economic sector in positions directly related to the program.
- ✓ Type of jobs held by graduates.
- ✓ Diversity of career opportunities.
- ✓ Establishment of an alumni association.
- ✓ Creation of small businesses by graduates of the specialty.
- ✓ Employer satisfaction.

G- Student assessment through continuous assessment and personal work :

G1- Assessment by Continuous Assessment :

The importance of continuous assessment methods on student training in terms of educational outcomes is no longer in doubt. In this regard, Articles 20, 21 and 22 of Order 712 of 3 November 2011 define and specify the methods and organization of continuous assessment of students according to the training course. The calculation of continuous assessment averages (supervised work and practical work) is based on a weighting of all the elements that make up this assessment. These articles specify that this weighting is left to the discretion of the teaching team.

A survey conducted by the CPND-ST among all teachers in the various university establishments showed heterogeneity in the implementation of continuous assessment of students. Therefore, we are led to admit a real deficit in the effective management of this pedagogical activity, which required serious reflection on this subject on our part, which, combined with proposals from several establishments, resulted in the recommendations below.

The analysis of the various proposals from these establishments showed that, indeed, Articles 21 and 22 of Order 712 of 3 November 2011 are not explicit enough and deserve more

clarification. These articles could be enriched by taking into account the following points which represent a summary of the proposals collected.

1. Proposals relating to subjects with supervised work :

1.1. Preparation of the exercise series:

The instructor in charge of the subject must organize the assignments by proposing a series of exercises for each chapter of the course. This series must be comprehensive, with exercises to help students understand the course and sample exercises to be completed during tutorial sessions.

These exercises must be prepared by the student before attending the tutorial session. This preparation may be assessed. The assessment method is left to the discretion of the instructor in charge of the tutorial.

Exercises not completed during the tutorial session may be the subject of individual work to be completed by groups of 3 to 4 students and submitted for assessment (deadline: 1 week).

1.2. Written questions :

Each end of a series of exercises (i.e. each end of a chapter) will be marked by a short written test. This test must be organized in collaboration with the subject head in order to ensure a fair assessment for all students (essentially when several teachers are involved in the tutorials).

1.3. Student participation in tutorials :

This participation must be assessed. The assessment method is left to the discretion of the teacher in charge of the tutorial.

1.4. Student attendance:

Student attendance is mandatory for tutorials and practical work. It is difficult to monitor attendance in lectures for undergraduate students, where class sizes are very large (lectures in lecture halls). For master's students, where class sizes are small, attendance must be mandatory for lectures and practical work.

2. Case of methodological units (Practical work) :

Just like tutorials, practical exercises must be prepared by the student. The instructor must organize a test to monitor this preparation before each practical session (in the form of short comprehension questions, multiple-choice questions, a diagram of the practical session, etc.).

A report (per working group) must be submitted at the end of the practical session. To this end, the instructor must prepare a standard report (outline) to facilitate the students' work so that they can effectively submit it at the end of the practical session.

At the end of the semester, the instructor organizes a practical test that summarizes all the practical work completed by the student.

3. About cross-curricular and discovery subjects that do not have tutorials or practical work :

It is very difficult to conduct continuous assessments in these subjects due to the absence of tutorial sessions and the very large number of students in most cases, particularly for universities with very large enrollments.

Nevertheless, the instructor in charge of this subject may, if they wish, inform students that they may be able to assess them (continuously) by asking them to prepare presentations, write reports, research course supplements, use free software, ask students to watch a popular science film related to the subject at home (after providing them with either the film

electronically or providing them with the internet link to it) and then ask them to submit a written report or give an oral presentation summarizing the film, etc.

The credits for these activities are left to the discretion of the instructor and the training team, who alone are qualified to determine the best way to factor this personal work into the overall grade for the final exam.

4. Harmonization of continuous monitoring :

Using a common assessment grid would promote the harmonization of these practices from one instructor to another, from one department to another, and from one institution to another. It would also provide a structuring and reassuring benchmark for students. To this end, we propose below an indicative assessment grid that presents the various continuous assessments used to evaluate the degree of student skill acquisition, whether in terms of knowledge, analytical skills, or synthesis abilities.

It should be noted that these assessments are not intended to "trap" students by imposing very difficult continuous assessments. On the contrary, the aim is to "honestly" assess the degree to which the student has assimilated the various skills and knowledge taught to them, in complete objectivity. In the same spirit, we would gain by promoting the contractualization of learning assessment by specifying, for example, the success criteria and good practices that would lead to correct and precise answers to questions. Thus, the assessment would focus mainly on the acquired knowledge that was the subject of training by giving exercises related to what was prepared in TD without forgetting, however, to evaluate the students' ability to mobilize their skills in more complex situations.

4-1 Practical work :

Preparation of exercise series and personal work (homework to be submitted, presentations, etc.)	30%	06 points
Written questions (minimum 2 questions including one proposed by the subject manager)	50%	10 points
Student participation in tutorials	20%	04 points
Total	**100%**	**20 points**

4.2 Practical work :

Practical work preparation tests	20%	04 points
Report (must be submitted at the end of the practical session)	40%	08 points
Practical test at the end of the semester on all the manipulations carried out by the student.	40%	08 points
Total	**100%**	**20 points**

G2- Student's personal work :

The student's personal work is part of the LMD spirit. A very substantial amount of time has been allocated to it each week: approximately 50% of the total training time (see the "Overall Training Summary" table in this training offer).

A survey conducted by the CPND-ST among training teams across all university establishments indicated that time spent on students' personal work could be used wisely, under good teacher supervision, rationally and in various forms. The tasks that would then be completed by volunteer students would be evaluated and counted (as a bonus) in their overall continuous assessment grade. The rate of this bonus is left to the discretion of the teaching teams.

The synthesis of the different proposals can be summarized in the following points:

1. Homework :

In order to enrich the knowledge and strengthen the training of students, they will be asked to carry out additional homework guided by their course or tutorial teachers. This type of work will involve, for example, encouraging students to do research to answer specific and/or conflicting questions raised during the course, solving a difficult exercise, reviewing in detail the demonstration of a theorem, researching the complement to a course, using free software or a CAD-CAM tool to make applications and simulations related to the course, etc. These activities can be evaluated, graded and registered as a bonus for the students who complete them.

2. Mini course project :

The mini-course project (1 to 3 weeks) is an effective way to prepare students for the methodology of expression, writing, and documentary research. It allows them to put into practice the techniques learned in cross-curricular subjects. It also allows them to develop a sense of group work.

The theme of the mini-course project must be clearly defined and determined by the instructor for a group of students (maximum 2 to 5). The project culminates in a single report (maximum 10 pages) and a short collective oral presentation (preferably with audiovisual support). A common grade for the group is awarded according to an evaluation grid (presentation of the document and use of bibliographic resources, oral presentation, adherence to time, responses to questions, etc.) and will then be included as a bonus in the continuous assessment grade.

3. Report of a visit, an educational outing or a discovery and/or immersion course :

Visits, field trips, and discovery and/or immersion internships are opportunities for students that can help them better understand the reality of the working world and ultimately help them achieve better professional integration.

Administrative managers and instructors should encourage, as much as possible, this very important aspect of the training and ensure the organization of visits and field trips throughout the program.

They should also help/encourage students to conduct research in economic institutions with the aim of finding (in L3 and M1) discovery and/or immersion internships of one to two weeks in the industrial environment during the winter and spring breaks.

In this context, instructors should ensure that students take notes during these trips and require reports (reports of a few pages). This activity can be evaluated, graded, and credited as a bonus for the student who completes it. Students can be provided with templates to help them present their internship reports effectively.

4. Participation in scientific events :

In order to instill a scientific mindset in students (especially for higher education students), they should be guided and encouraged to participate in round tables, laboratory seminars and

conferences organized within their faculty and/or institution. It is even advisable to encourage these students to attend conferences related to their specialty outside their university at exhibitions, fairs and other events. This activity can be evaluated, graded and recorded as a bonus for the student who completes it.

5. Use of New Information and Communication Technologies :

ICTs are very attractive to students. Teachers should encourage them to use these technologies to create spaces for exchange among themselves (promotion pages, discussion forums on a specific course issue, etc.). The teacher can also participate in the group as an online evaluator. This activity can be evaluated, graded, and recorded as a bonus for students who participate.

Conclusion :

Student autonomy, considered a key to success, relies largely on the personal work students undertake, utilizing the resources and tools made available to them. All of this must, of course, be supervised and formalized within the framework of the educational and support programs provided jointly by the university instructor and the administrative manager throughout their training program.

This autonomy will allow them to build their professional identity based on their aspirations, abilities, and prior learning, and to further their academic path as they pursue higher education.

4 - Available human resources :

A : Supervision capacity (expressed in number of students that can be supported) :

Number of students :

B : Internal teaching team mobilized for the specialty: (To be completed and endorsed by the faculty or institute)

First and last name	Graduation Diploma	Specialized diploma (Magister, doctorate)	Grade	Subjects to be taught	Signing in

Departmental visa **Faculty or institute visa**

C : External teaching team mobilized for the specialty: (To be completed and endorsed by the faculty or institute)

First and last name	Establishment of attachment	Graduation Diploma	Specialized diploma (Magister, doctorate)	Grade	Subjects to be taught	Signing in

Departmental visa **Faculty or institute visa**

D : Overall summary of human resources mobilized for the specialty (L3) :

Grade	Internal Staff	External Staff	Total
Professors			
Lecturers (A)			
Lecturers (B)			
Assistant Professor (A)			
Assistant Professor (B)			
Other (*)			
Total			

(*)Technical and support staff

5 - Material resources specific to the specialty

A- Educational Laboratories and Equipment: Sheet of existing educational equipment for the practical work of the planned training (1 sheet per laboratory)

Laboratory title :

Student capacity :

N°	Equipment designation	Number	Observations

B- Internships and company training: (see agreements/conventions section)

Internship location	Number of students	Duration of the internship

C- Documentation available at the establishment level specific to the training offered (Mandatory field) :

D- Personal work and ICT spaces available at department and faculty level **:**

II – Half-yearly organization sheets for the specialty courses

Semester 1

Teaching unit	module	Credits	Coefficient	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**TP**			**Continuous Assessment**	Exam
Fundamental Course Code: UEF 1.1 Credits: 18 Coefficients: 9	Mathematics 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physics 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Structure of matter	6	3	3h00	1h30		67h30	82h30	40%	60%
Methodology Course Code: UEM 1.1 Credits: 9 Coefficients: 5	TP Physics 1	2	1			1h30	22h30	27h30	100%	
	TP Chemistry 1	2	1			1h30	22h30	27h30	100%	
	Computer Science 1	4	2	1h30		1h30	45h00	55h00	40%	60%
	Writing methodology	1	1	1h00			15h00	10h00		100%
Discovery Course Code: UED 1.1 Credits: 1 Coefficients: 1	Careers in Science and Technology 1	1	1	1h30			22h30	02h30		100%
E Cross-Curricular Code: UET 1.1 Credits: 2 Coefficients: 2	Ethical dimension and deontology (the foundations)	1	1	1h30			22h30	02h30		100%
	Foreign Language 1 (French or English)	1	1	1h30			22h30	02h30		100 %
Total semester 1		**30**	**17**	**16h00**	**4h30**	**4h30**	**375h00**	**375h00**		

Semestre 2

Teaching unit	module	Credits	Coefficient	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**TP**			Titled	Exam
Fundamental Course Code: UEF 1.2 Credits: 18 Coefficients: 9	Mathematics 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physics 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Thermodynamics	6	3	3h00	1h30		67h30	82h30	40%	60%
Methodology Course Code: UEM 1.2 Credits: 9 Coefficients: 5	TP Physics 2	2	1			1h30	22h30	27h30	100%	
	TP Chemistry 2	2	1			1h30	22h30	27h30	100%	
	Computer Science 2	4	2	1h30		1h30	45h00	55h00	40%	60%
	Presentation methodology	1	1	1h00			15h00	10h00		100%
Discovery Course Code: UED 1.2 Credits: 1 Coefficients: 1	Careers in Science and Technology 2	1	1	1h30			22h30	02h30		100%
E Cross-Curricular Code: UET 1.2 Credits: 2 Coefficients: 2	Foreign Language 2 (French and/or English)	2	2	3h00			45h00	05h00		100 %
Total semester 2		**30**	**17**	**16h00**	**4h30**	**4h30**	**375h00**	**375h00**		

Semestre 3

Teaching unit	module	Credits	Coefficient	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			Course	TD	TP			Titled	Exam
Fundamental Course Code : UEF 2.1.1 Credits : 10 Coefficients : 5	Mathematics 3	6	3	3h00	1h30		67h30	82h30	40%	60%
	Waves and vibrations	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 2.1.2 Crédits : 8 Coefficients : 4	Fundamental Electronics 1	4	2	1h30	1h30		45h00	55h00	40%	60%
	fundamental electrotechnical 1	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Methodology Code : UEM 2.1 Credits : 9 Coefficients : 5	Probability and statistics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Computer Science 3	2	1			1h30	22h30	27h30	100%	
	TP Electronics et Electrotechnical	2	1			1h30	22h30	27h30	100%	
	TP Waves and vibrations	1	1			1h00	15h00	10h00	100%	
UE Discovery Code : UED 2.1 Credits : 2 Coefficients : 2	State of the art of electrical engineering	1	1	1h30			22h30	02h30		100%
	Energies et environnement	1	1	1h30			22h30	02h30		100%
UE Transversal Code : UET 2.1 Crédits : 1 Coefficients : 1	Technical English	1	1	1h30			22h30	02h30		100%
Total semester 3		**30**	**17**	**13h30**	**7h30**	**4h00**	**375h00**	**375h00**		

Semestre 4

Teaching unit	module	Credits	Coefficient	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**TP**			Titled	Exam
UE Fundamental Code : UEF 2.2.1 Credits : 10 Coefficients : 5	Fundamental electrotechnical 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Combinatorial and sequential logic	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 2.2.2 Credits : 8 Coefficients : 4	Numerical methods	4	2	1h30	1h30		45h00	55h00	40%	60%
	Signal theory	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Methodology Code : UEM 2.2 Credits : 9 Coefficients : 5	Electrical and electronic measurements	3	2	1h30		1h00	37h30	37h30	40%	60%
	TP Fundamental electrotechnical 2	2	1			1h30	22h30	27h30	100%	
	TP Combinatorial and sequential logic	2	1			1h30	22h30	27h30	100%	
	TP Numerical methods	2	1			1h30	22h30	27h30	100%	
UE Discovery Code : UED 2.2 Credits : 2 Coefficients : 2	Production of electrical energy	1	1	1h30			22h30	02h30		100%
	Electrical safety	1	1	1h30			22h30	02h30		100%
UE Transversal Code : UET 2.2 Credits : 1 Coefficients : 1	Techniques of expression, information and communication	1	1	1h30			22h30	02h30		100%
Total semester 4		**30**	**17**	**13h30**	**6h00**	**5h30**	**375h00**	**375h00**		

Semestre 5

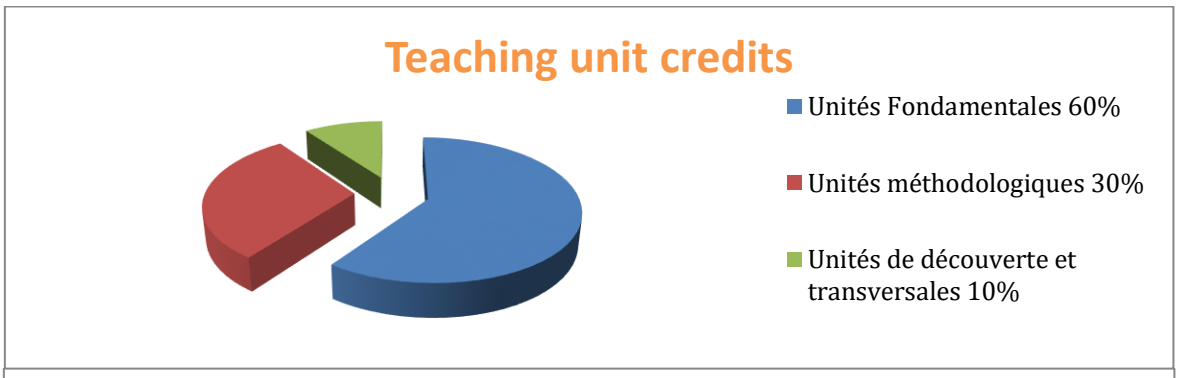
Teaching unit	module	Credits	Coefficient	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**TP**			Titled	Exam
UE Fundamental Code : UEF 3.1.1 Credits : 10 Coefficients : 5	Electrical Networks	6	3	3h00	1h30		67h30	82h30	40%	60%
	Power Electronics	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 3.1.2 Credits : 8 Coefficients : 4	Servo Systems	4	2	1h30	1h30		45h00	55h00	40%	60%
	Electromagnetic Field Theory	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Methodology Code : UEM 3.1 Credits : 9 Coefficients : 5	Diagrams and Electrical Equipment	3	2	1h30		1h00	37h30	37h30	40%	60%
	TP Electrical Networks	2	1			1h30	22h30	27h30	100%	
	TP Power Electronics	2	1			1h30	22h30	27h30	100%	
	TP Servo Systems / TP sensors	2	1			1h30	22h30	27h30	100%	
UE Discovery Code : UED 3.1 Credits : 2 Coefficients : 2	Sensors and Metrology	1	1	1h30			22h30	02h30		100%
	Electrical systems design	1	1	1h30			22h30	02h30		100%
UE Transversal Code : UET 3.1 Credits : 1 Coefficients : 1	Simulation software	1	1	1h30			22h30	02h30		100%
Total semester 5		**30**	**17**	**13h30**	**6h00**	**5h30**	**375h00**	**375h00**		

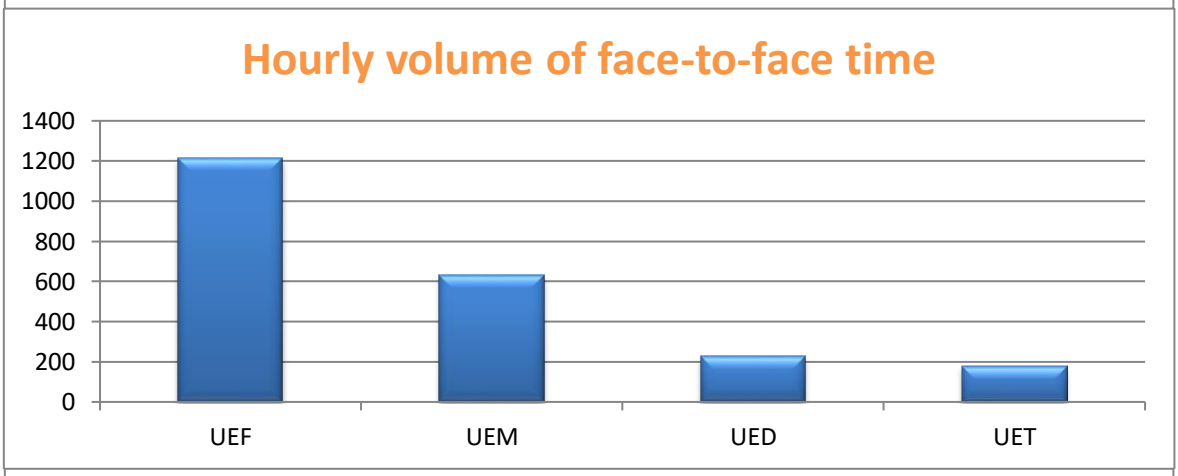
Semestre 6

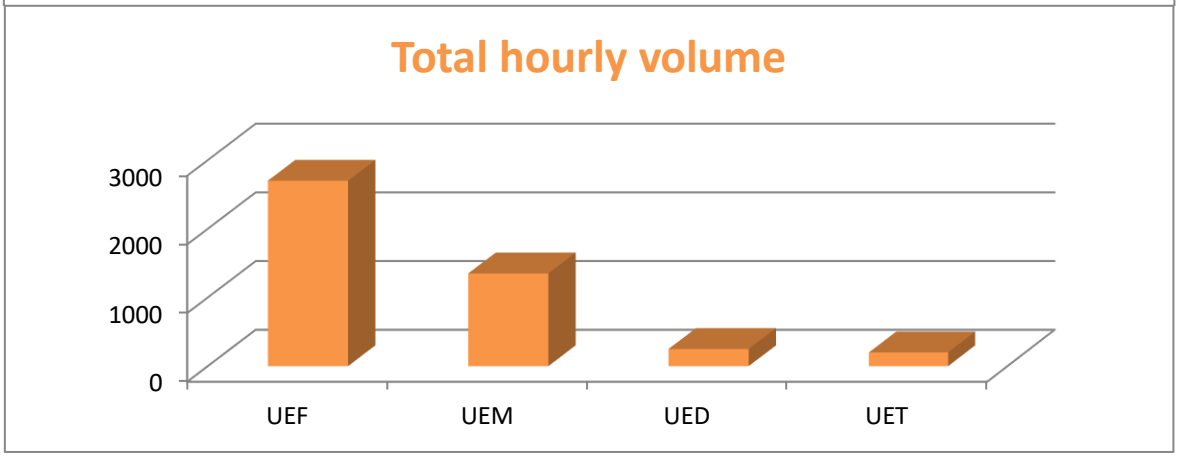
Teaching unit	module	Credits	Coefficient	Weekly hourly volume			Half-Yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Assessment method	
	Titled			**Course**	**TD**	**TP**			Titled	Exam
UE Fundamental Code : UEF 3.2.1 Credits : 10 Coefficients : 5	Control of electrical machines	6	3	3h00	1h30		67h30	82h30	40%	60%
	Industrial regulation	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Fundamental Code : UEF 3.2.2 Credits : 8 Coefficients : 4	Industrial Automation	4	2	1h30	1h30		45h00	55h00	40%	60%
	Materials and Introduction to High Voltage	4	2	1h30	1h30		45h00	55h00	40%	60%
UE Methodology Code : UEM 3.2 Credits : 9 Coefficients : 5	End of Cycle Project	4	2			3h00	45h00	55h00	100%	
	TP Control of electrical machines	1	1			1h00	15h00	10h00	100%	
	TP Industrial regulation	2	1			1h30	22h30	27h30	100%	
	TP Automation / TP Materials and HT	2	1			1h30	22h30	27h30	100%	
UE Discovery Code : UED 3.2 Credits : 2 Coefficients : 2	Protection of electrical networks	1	1	1h30			22h30	02h30		100%
	Industrial Maintenance	1	1	1h30			22h30	02h30		100%
UE Transversal Code : UET 3.2 Credits : 1 Coefficients : 1	Entrepreneurship and business management	1	1	1h30			22h30	02h30		100%
Total semester 6		**30**	**17**	**12h00**	**6h00**	**7h00**	**375h00**	**375h00**		

Récapitulatif global de la formation :

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







III - Detailed program by subject

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

Teaching objectives

This first mathematics subject is particularly dedicated to standardizing the level of students entering university. The first new elements are taught progressively in order to lead students towards more advanced mathematics. The concepts covered in this subject are fundamental and among the most used in the field of Science and Technology.

Recommended prior knowledge

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

Content of the material:

Chapter 1. Methods of Mathematical Reasoning (1 Week)
1-1 Direct Reasoning. 1-2 Reasoning by Contraposition. 1-3 Reasoning by Adversarial Probability. 1-4 Reasoning by Contraexample. 1-5 Reasoning by Induction.

Chapter 2. Sets, Relations, and Applications (2 Weeks)
2.1 Set Theory.
2-2 Order Relation, Equivalence Relations. 2-3 Injective, Surjective, and Bijective Applications: Definition of an Application, Direct Image, Inverse Image, Characteristics of an Application.

Chapter 3. Real Functions with 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 Expansion (2 Weeks)
5-1 Taylor's Formula. 5-2 Limited Expansion. 5-3 Applications.

Chapter 6. Linear Algebra (4 Weeks)
6-1 Laws and Internal Composition. 6-2 Vector Space, Basis, Dimension (Elementary Definitions and Properties). 6-3 Linear Application, Kernel, Range, Rank.

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

Bibliographic references:

1- K. Allab, Elements of Analysis, Function of a Real Variable, 1st & 2nd Years of University, Office of University Publications.
2- J. Rivaud, Algebra: Preparatory Classes and University Volume 1, Exercises with Solutions, Vuibert.
3- N. Faddeev, I. Sominski, Collection of Higher Algebra Exercises, Moscow Edition
4- M. Balabne, M. Duflo, M. Frish, D. Guegan, Geometry – 2nd Year of the Undergraduate Preparatory Classes, Vuibert University.

5- B. Calvo, J. Doyen, A. Calvo, F. Boshet, Algebra Exercises, 1st Cycle of Science Preparation for Grandes Écoles, 2nd Year, Armand Colin – Collection U.
6- J. Quinet, Elementary Course in Higher Mathematics 1- Algebra, Dunod.
7- J. Quinet, Elementary Course in Higher Mathematics 2- Usual Functions, Dunod.
8- J. Quinet, Elementary Course in Higher Mathematics 3- Integral Calculus and Series, Dunod.
9- J. Quinet, Elementary Course in Higher Mathematics 4- Differential Equations, Dunod.

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

Course Objectives

To introduce students to the fundamentals of Newtonian physics through three main sections: Kinematics, Dynamics, and Work and Energy.
Connaissances préalables recommandées
Notions de mathématiques et de Physique.

Subject Content:

Mathematical Review (2 Weeks)

1- Dimensional Equations
2- Vector Calculus: Scalar Product (Norm), Cross Product, Multivariate Functions, Differentiation. Vector Analysis: Gradient Operators, Rotational Operators, etc.

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 a Material Point in Different Coordinate Systems. 4- Relative Motion.

Chapter 2. Dynamics: (4 Weeks)

1- General: Mass - Force - Torque - Absolute and Galilean Frames. 2- Newton's Laws. 3- Principle of Conservation of Momentum. 4- Differential Equation of Motion. 5- Angular Momentum. 6- Applications of the fundamental law for forces (constant, time-dependent, velocity-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 Assessment: 40%; Exam: 60%.

Bibliographic references:

1. A. Gibaud, M. Henry; Physics Course - Mechanics of the Point - Course and Corrected Exercises; 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
Teaching unit: UEF 1.1
matter 3: Structure of matter
VHS: 67h30 (Course: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives

This subject allows students to acquire basic chemistry formalisms, particularly those describing the atom and chemical bonds, chemical elements, and the periodic table with energy quantification. Students are better equipped to solve chemistry problems.

Recommended Prior Knowledge

Basic concepts of mathematics and general chemistry.

Course Content:

Chapter 1: Fundamental Concepts (2 Weeks)

Macroscopic states and characteristics of states of matter, changes of state of matter, concepts of atom, molecule, mole, and Avogadro's number, atomic mass unit, atomic and molecular molar mass, molar volume, the Law of Mass: Conservation of Mass (Lavoisier), chemical reactions, qualitative aspects of matter, and quantitative aspects of matter.

Chapter 2: Main Constituents of Matter (3 Weeks)

Introduction: Faraday's Experiment: Relationship between matter and electricity, Identification of the constituents of matter and therefore of the atom, and some physical properties (mass and charge), Rutherford's planetary model, Presentation and characteristics of the atom (Symbol, atomic number Z, mass number A, number of protons, neutrons, and electrons), Isotopy and relative abundance of different isotopes, Separation of isotopes and determination of atomic mass and average mass of an atom: Mass spectrometry: Bainbridge spectrograph, Binding and cohesive 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's Atomic Model: Hydrogen Atom, The Hydrogen Atom in Wave Mechanics, Polyelectronic Atoms in Wave Mechanics.

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

D. Mendeleev's Periodic Table, Modern Periodic Table, Evolution and Periodicity of the Physicochemical Properties of the Elements, Calculation of Radii (Atomic and Ionic), Successive Ionization Energies, Electron Affinity, and Electronegativity (Mulliken Scale) Using Slater's Rules.

Chapter 6: Chemical Bonds (3 Weeks)

Covalent Bonding in Lewis Theory, Polarized Covalent Bonding, Dipole Moment, and Partial Ionic Character of the Bond, Geometry of Molecules: Gillespie Theory or VSEPR, Chemical Bonding in the Quantum Model.

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

Bibliographic References

1. Ouahes, Devallez, General Chemistry, OPU.
2. S.S. Zumdhal & coll., General Chemistry, De Boeck University.
3. Y. Jean, Electronic Structure of Molecules: 1 from the Atom to Simple Molecules, 3rd edition, Dunod, 2003.
4. F. Vassaux, Chemistry in IUT and BTS (University Institute of Technology) (BTS).
5. A. Casalot & A. Durupthy, Inorganic Chemistry: A Graduate Course, Hachette.
6. P. Arnaud, Physical Chemistry Course, Dunod.
7. M. Guymont, Structure of Matter, Belin Coll., 2003.
8. G. Devore, General Chemistry: T1, Study of Structures, Coll. Vuibert, 1980.
9. M. Karapetiantz, Constitution of Matter, Ed. Mir, 1980.

Semester: 1
Teaching unit : UEM 1.1
matter 1: TP Physics 1
VHS: 22h30 (TP: 1h30)
CrEdits: 2
Coefficient: 1

Course Objectives

Consolidate the theoretical knowledge provided in the course through a number of practical exercises.

Recommended Prior Knowledge

Basic knowledge of mathematics and physics.

Course Content:

At least 5 practical exercises (3 hours / 15 days):

- Methodology for presenting practical reports and calculating errors.
- Verification of Newton's 2nd Law
- Free Fall
- Simple Pendulum
- Elastic Collisions
- Inelastic Collisions
- Moment of Inertia
- Centrifugal Force

Assessment Method:

Continuous Assessment: 100%.

Semester: 1
Teaching unit : UEM 1.1
matter 2: TP Chemistry 1
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

Course Objectives
Consolidate the theoretical knowledge provided in the Structure of Matter course through a number of practical exercises.

Recommended Prior Knowledge
Basic Chemistry Concepts

Course Content:

1. Laboratory Safety
2. Preparation of Solutions
3. Concepts of Uncertainty Calculations Applied to Chemistry
4. Acid-Base Determination by Colorimetry and pH-metry
5. Acid-Base Determination by Conductivity Meter
5. Oxidation-Reduction Determination
6. Determination of Water Hardness
7. Determination of Ions in Water: Determination of Chloride Ions by the Mohr Method

Assessment Method:
Continuous Assessment: 100%

Semestre: 1
Teaching unit : UEM 1.1
matter 3: Computer Science 1
VHS: 45h00 (Course: 1h30, TP: 1h30)
Credits: 4
Coefficient: 2

Objective and Recommendations:

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

Recommended Prior Knowledge:

Basic knowledge of web technology.

Subject Content:

Part 1. Introduction to Computer Science (5 Weeks)

1- Definition of Computer Science
2- Evolution of Computer Science and Computers
3- Information Coding Systems
4- Operating Principles of a Computer
5- Hardware of a Computer
6- System Section
7- Basic Systems (Operating Systems (Windows, Linux, Mac OS, etc.))
8- Programming Languages, Application Software

Part 2. Algorithm and Program Concepts (10 Weeks)

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

Computer Science Practicals 1:

The practicals are intended to illustrate the concepts taught during the course. They should begin with the lectures according to the following schedule:

• Introductory and familiarization practicals with the computer from a hardware and operating system perspective (exploring the various operating system features)

• Introductory practicals on using a programming environment (editing, assembly, compilation, etc.)

• Practicals applying programming techniques covered in lectures.

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Bibliographic References

1- John Paul Mueller and Luca Massaron, Algorithms for Dummies (Large Format), 2017.

2- Charles E. Leiserson, Clifford Stein, and Thomas H. Cormen, Algorithmics: A Course with 957 Exercises and 158 Problems, 2017.

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

Semester: 1
Teaching unit : UEM 1.1
Matter 4: Méthodologie de la rédaction
VHS: 15h00 (Course: 1h00)
Credits: 1
Coefficient: 1

Course Objectives

To familiarize and train students with current concepts of writing methodology used in the science and technology profession. Skills to be acquired include: Knowing how to present oneself; Knowing how to write a CV and cover letter; Knowing how to position oneself in writing or orally regarding an opinion or idea; and Mastering syntax and spelling in writing.

Recommended Prior Knowledge

Basic French. Basic principles of writing a document.

Course Content:

Chapter 1. Concepts and Generalities of Writing Techniques (2 Weeks)
- Definitions, Standards
- Applications: Writing a Summary, a Letter, a Request

Chapter 2. Information Search, Synthesis, and Analysis (3 Weeks)
- Searching for Information in a Library (Print Format: Books, Journals)
- Searching for Information on the Internet (Digital: Databases; Search Engines, etc.)
- Applications

Chapter 3 Writing Techniques and Procedures (3 Weeks)
- Basic Principles of Writing - Punctuation, Syntax, Sentences
- Sentence Length
- Paragraphing
- Using a Neutral Style and Writing in the Third Person
- Readability
- Objectivity
- Intellectual Rigor and Plagiarism

Chapter 4 Writing a Report (4 Weeks)

Cover Pages, Table of Contents, Introduction, Method, Results, Discussion, Conclusion, Bibliography, Appendices, Summary, and Keywords

Chapter 5. Applications (3 Weeks)

Report of a Practical Assignment

Assessment Method:

Assessment Exam: 100%.

Bibliographic references:

1. J.-L. Lebrun, Practical Guide to Scientific Writing, EDP Sciences, 2007.

2. M. Fayet, Successful Report Writing, 3rd edition, Eyrolles, 2009.

3. M. Kalika, Master's Thesis - Managing a Thesis, Writing a Report, Preparing for a Defense, Dunod, 2016.

4. M. Greuter, Successful Thesis Writing and Internship Report, L'Etudiant, 2014.

5. F. Cartier, Written and Oral Communication, Edition GEP- Groupe Eyrolles, 2012.

6. M. Fayet, Methods of Written and Oral Communication, 3rd edition, Dunod, 2008.

7. E. Riondet, P. Lenormand, The Big Book of Letter Templates, 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, The practice of correspondence, 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 Professional English, Springer, 2014.

Semester: 1
Teaching unit: UED 1.1
Matter 1: Careers in Science and Technology 1
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Subject Objective:
Introduce students, in the first phase, to all the fields covered by the Science and Technology field, and in the second phase, to a wide range of careers that these fields can lead to. In the same context, this subject introduces the new challenges of sustainable development and the new careers that can arise from them.

Recommended prior knowledge
None.

Subject Content:

1. What is engineering science? (2 weeks)
The engineering profession: history and challenges of the 21st century. Search for a job/job ad using keywords and develop a simple job description (job title, company, main activities, required skills (knowledge, know-how, interpersonal skills).

2. Electronics, Telecommunications, Biomedical Engineering, Electrical Engineering, Electromechanics, Optics & Precision Mechanics: (2 weeks)
- Definitions, areas of application (Home automation, embedded automotive applications, Video surveillance, Mobile telephony, Fiber optics, Advanced scientific instrumentation, Imaging and medical instrumentation, Giant mirrors, Contact lenses, Electric power transmission and distribution, Power generation plants, Energy efficiency, Industrial equipment maintenance, Elevators, Wind turbines, etc.)
- Role of the specialist in these fields.

3. Automation and Industrial Engineering: (1 week)
- Definitions, Application areas (Automated industrial lines, CNC machine tools, Robotics, Inventory management, Freight flow management, Quality) - Role of the specialist in these fields.

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

5. Sustainable Development (SD): (4 weeks)
Definitions, Global Issues (climate change, demographic transitions, resource depletion (oil, gas, coal, etc.), biodiversity loss, etc.), SD Diagram (Sustainable = Viable + Livable + Equitable), SD Stakeholders (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/eco-mobility, resource recovery (water, metals and minerals, etc.), sustainable production), Relevance of Sustainable Engineering in Science and Technology (S&T) programs, Relationship between sustainability and engineering, Responsibility of engineers in implementing sustainable projects, etc.

Student's own work for this subject:

The teacher in charge of this subject can inform their students that they can still assess them by offering them Prepare job descriptions. Ask students to watch a popular science film related to their chosen career at home (after providing them with either the film electronically or providing them with the internet link to it) and then ask them to submit a written report or give an oral presentation summarizing the film, etc. The credits for these activities are left to the discretion of the instructor and the training team, who alone are qualified to determine the best way to factor this personal work into the overall grade for the final exam.

Group work: Create job descriptions for careers in each sector based on recruitment advertisements found on job application websites (e.g., http://www.onisep.fr/Decouvrir-les-metiers, www.indeed.fr, www.pole-emploi.fr) (1 sector/group).
Depending on the institutions' capabilities, recommend involving doctoral students and former graduates in a tutoring/mentoring program where each group can call upon their tutor/mentor to develop the job description and learn about the various ST professions.

Assessment Method:
100% Exam

Bibliographic references:
1- What careers for tomorrow? Publisher: ONISEP, 2016, Collection: Les Dossiers.
2- J. Douënel and I. Sédès, Choosing a career according to your profile, Editions d'Organisation, Collection: Emploi & carrière, 2010.
3- V. Bertereau and E. Ratière, What career are you made for? Publisher: L'Étudiant, 6th edition, Collection: Métiers, 2015.
4- The Big Book of Careers, Publisher: L'Étudiant, Collection: Métiers, 2017.
5- Careers in the Aeronautics and Space Industry, Collection: Parcours, Published by ONISEP, 2017.
6- Careers in Electronics and Robotics, Collection: Parcours, Published by ONISEP, 2015.
7- Careers in the Environment and Sustainable Development, Collection: Parcours, Published by ONISEP, 2015.
8- Careers in Construction and Public Works, Collection: Parcours, Published by ONISEP, 2016.
9- Careers in Transportation and Logistics, Collection: Parcours, Published by ONISEP, 2016.
10- Careers in Energy, Collection: Parcours, Published by ONISEP, 2016.
11- Careers in Mechanics, Collection: Parcours, Published by: ONISEP, 2014.
12- Careers in Chemistry, Collection: Parcours, Published by: ONISEP, 2017.
13- Careers in the Web, Collection: Parcours, Published by: ONISEP, 2015.
14- Careers in Biology, Collection: Parcours, Published by: ONISEP, 2016.

Semester: 1
Teaching unit : UET 3.1
Matter : Ethical and deontological dimension (the foundations)
VHS : 22h30 (Cours : 1h30)
Credits : 1
Coefficient : 1

Teaching Objectives:

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

Recommended Prior Knowledge:

None

Subject Content:

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

II. References – Islam (2 weeks)

Philosophical References
Religious References
The Evolution of Civilizations
Institutional References

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

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

V. Rights and Duties (2 weeks)

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

VI. University Relations (2 weeks)

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

VII. Practices (2 weeks)

Best Practices For the Instructor
Best Practices For the Student

Bibliographic References

1. Collection of Ethics and Professional Conduct Courses from Algerian Universities.
2. BARBERI (J.-F.), 'Morality and Corporate Law', Les Petites Affiches, No. 68, June 7, 1995.
3. J. Russ, Contemporary Ethical Thought, Paris, puf, Que sais-je?, 1995.
4. LEGAULT, G. A., Professionalism and Ethical Deliberation, Quebec, Presses de l'Université du Québec, 2003.
5. SIROUX, D., 'Ethics', in M. Canto-Sperber (ed.), Dictionary of Ethics and Moral Philosophy, Paris, Quadrige, 2004.
6. Prairat, E. (2009). Teaching Professions in the Age of Ethics. Education and Societies, 23.
7. https://elearning.univ-annaba.dz/pluginfile.php/39773/mod_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ontologie.pdf .

Semester: 1
Teaching unit: UET 1.1
Matter 1: French language1
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:
This subject aims to develop the following four skills: Listening Comprehension, Reading Comprehension and Oral Expression, and Written Expression through reading and studying texts.

Recommended Prior Knowledge:
Basic French.

Subject Content:
Below, we offer a set of topics covering fundamental sciences, technology, economics, social issues, communication, sports, health, etc. The teacher can choose texts from this list to explore during the lesson. Otherwise, they are free to explore other topics of their choice. The texts can be taken from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular journals, books, websites, audio and video recordings, etc.
For each text, the teacher helps the student develop their linguistic skills: listening, comprehension, and oral and written expression. In addition, he must use this text to identify the grammatical structures that he will develop during the same course session. We recall here, for illustration purposes, a set of grammatical structures that can be developed as examples. Of course, it is not a question of developing them all or in the same way. Some can be recalled and others in great detail.

Examples of themes	Grammatical structures
Climate change Pollution The electric car Robots Artificial intelligence The Nobel Prize The Olympic Games Sports at school The Sahara Currency Assembly line work Ecology Nanotechnologies Fiber optics The engineering profession The power plant Energy efficiency The smart building Wind energy Solar energy	Punctuation. Proper nouns, Articles. Grammatical functions: Noun, Verb, Pronouns, Adjective, Adverb. The complement pronoun "le, la, les, lui, leur, y, en, me, te, …" Agreement. Negative sentences. Ne … pas, Ne … pas encore, Ne … plus, Ne … jamais, Ne … point, … Interrogative sentences. Questions with "Qui, Que, Quoi", Questions with "Quand, Où, Combien, Pourquoi, Comment, Quel, Lequel". Exclamatory sentences. Reflexive verbs. Impersonal verbs. Indicative tenses: Present, Future, Past Perfect, Simple Past, Imperfect. …

Assessment method:
Exam: 100%.

Bibliographic references:

1. M. Badefort, Objective: International French Test, Edulang, 2006.
2. O. Bertrand, I. Schaffner, Passing the TCF, Exercises and Training Activities, Les éditions de l'école polytechnique, 2009.
3. M. Boulares, J.-L. Frerot, Progressive French Grammar with 400 Exercises, Advanced Level, CLE International.
4. Collective, Besherelles: Grammar for Everyone, Hatier.
5. Collective, Besherelles: Conjugation for Everyone, Hatier. 6. M. Grégoire, Progressive French Grammar with 400 Exercises, Beginner Level, CLE International, 1997.
7. A. Hasni et al., Training for Teaching Science and Technology in Secondary Schools, University of Quebec Press, 2006.
8. J.-L. Lebrun, Practical Guide to Scientific Writing, EDP Sciences, 2007.
9. J.M. Robert, Difficulties with French, Hachette,
10. C. Tisset, Teaching French in Schools: Grammar, Spelling and Conjugation, Hachette Education, 2005.
11. J. Bossé-Andrieu, Summary of Grammar and Spelling Rules, University of Quebec Press, 2001.
12. J.-P. Colin, French Simply, Eyrolles, 2010.
13. Collective, French Assessment Test, Hachette, 2001.
14. Y. Delatour et al., Practical French Grammar in 80 Worksheets with Corrected Exercises, Hachette, 2000.
15. Ch. Descotes et al., The Exercise Book: French Expression for the Intermediate Level, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, On the Browsing, Heinle Cengage Learning, 2011.
17. J. Dubois et al., The Essentials – Spelling, Larousse, 2009.

Semester: 1
Teaching unit: UET 1.1
Matter 1: English language1
VHS: 22h30 (Cours: 1h30)
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)
	Too Much or Too Little
Centrifugal Governors.	Instructions (Imperative)
Impulse Turbines.	Requirements and Necessity
The Petro Engine.	Means (by + Noun or –ing)
The Carburation System.	Time Statements
The Jet Engine.	Function, Duty
The Turbo-Prop Engine.	Alternatives
Aerofoil.	

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
Matter 1: Mathematics 2
VHS: 67h30 (Course: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Course Objectives

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

Recommended Prior Knowledge

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

Course Content:

Chapter 1: Matrices and Determinants (3 Weeks)

1-1 Matrices (Definition, Operation). 1-2 Matrix Associated with a Linear Map. 1-3 Linear Map Associated with a Matrix. 1-4 Change of Base, Transition Matrix.

Chapter 2: Systems of Linear Equations (2 Weeks)

2-1 General Information. 2-2 Study of the Solution Set. 2-3 Methods for Solving a Linear System. Solving by Cramer's Method. Solving by the Inverse Matrix Method. Solving by Gauss's 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 Second-Order Ordinary Differential Equations with Constant Coefficients.

Chapter 5: Functions of Several Variables (2 Weeks)

5-1 Limit, Continuity, and Partial Derivatives of a Function. 5-2 Differentiability. 5-3 Double and Triple Integrals.

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Bibliographic References:

1- F. Ayres Jr., Theory and Applications of Differential and Integral Calculus - 1175 Answered Exercises, McGraw-Hill.
2- F. Ayres Jr., Theory and Applications of Differential Equations - 560 Answered Exercises, McGraw-Hill.
3- J. Lelong-Ferrand, J.M. Arnaudiès, Mathematics Course - Differential Equations, Multiple Integrals, Volume 4, Dunod University.
4- M. Krasnov, Collection of Problems on Ordinary Differential Equations, Moscow Edition
5- N. Piskounov, Differential and Integral Calculus, Volume 1, Moscow Edition
6- J. Quinet, Elementary Course in Advanced Mathematics 3 - Integral Calculus and Series, Dunod.
7- J. Quinet, Elementary Course in Advanced Mathematics 4 - Differential Equations, Dunod.
8- J. Quinet, Elementary Course in Advanced Mathematics 2 - Usual Functions, Dunod.
9- J. Quinet, Elementary Course in Advanced Mathematics 1 - Algebra, Dunod.
10- J. Rivaud, Algebra: Preparatory Classes and University Volume 1, Exercises with Solutions, Vuibert.
11- N. Faddeev, I. Sominski, Collection of Higher Algebra Exercises, Moscow Edition.

Semester: 2
Teachnig unit: UEF 1.2
Matter 2: Physics 2
VHS: 67h30 (Course: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Course Objectives

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

Recommended Prior Knowledge

Mathematics 1, Physics 1.

Subject Content:

Mathematical Review: (1 Week)

1- Elements of length, surface area, and volume in Cartesian, cylindrical, and spherical coordinate systems. Solid angle, operators (gradient, rotational, Nabla, Laplacian, and divergence).
2- Multiple Derivatives and Integrals.

Chapter I. Electrostatics: (6 Weeks)

1- Electrostatic Charges and Fields. Electrostatic Interaction Force - Coulomb's Law.
2- Electrostatic Potential. 3- Electric Dipole. 4- Electric Field Flux. 5- Gauss's Theorem. 6- Conductors in Equilibrium. 7- Electrostatic Pressure. 8- Capacitance of a Conductor and a Capacitor.

Chapter II. Electrokinetics: (4 Weeks)

1- Electrical Conductor. 2- Ohm's Law. 3- Joule's Law. 4- Electrical 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's Law, Ampere's Theorem, Calculation of magnetic fields created by steady currents.
2- Induction Phenomena: Induction phenomena (circuit in a variable magnetic field and moving circuit in a permanent magnetic field), Lorentz Force, Laplace Force, Faraday's Law, Lenz's Law, Application to Coupled Circuits.

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Bibliographic references:

1. J.-P. Perez, R. Carles, R. Fleckinger; Electromagnetism: Fundamentals and Applications, Dunod, 2011.
2. H. Djelouah; Electromagnetism; Office of University Publications, 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
Teachnig unit: UEF 1.2
Matter 3: Thermodynamics
VHS: 67h30 (Course: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives

To provide the necessary foundations of classical thermodynamics for applications to combustion and thermal engines. To standardize student knowledge. The skills to be acquired are: Acquisition of a scientific basis for classical thermodynamics; Application of thermodynamics to various systems; Statement, explanation, and understanding of the fundamental principles of thermodynamics.

Recommended Prior Knowledge

Basic concepts of mathematics and general chemistry.

Course Content:

Chapter 1: Generalities of Thermodynamics (3 Weeks)

1- Fundamental properties of state functions. 2- Definitions 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)

1. Work, heat, internal energy, concept of conservation of energy. 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)

Heats of reaction, standard state, standard enthalpy of formation, enthalpy of dissociation, enthalpy of change of physical state, enthalpy of a chemical reaction, Hess's law, Kirchoff's law.

Chapter 4: The Second Law of Thermodynamics (3 weeks)

1- The Second Law for a closed system. 2. Statement of the 2nd Law: Entropy of a closed isolated system. 3. Calculation of the change in entropy: reversible isothermal transformation, reversible isochoric transformation, reversible isobaric transformation, adiabatic transformation, during a change of state, during a chemical reaction.

Chapter 5: The 3rd 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%.

Bibliographic References:

1. C. Coulon, S. Le Boiteux S. and P. Segonds, Thermodynamics Physics - Course and Exercises with Solutions, Dunod Publishing.

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

3. R. Clerac, C. Coulon, P. Goyer, S. Le Boiteux & C. Rivenc, Thermodynamics, Course and Tutorials in Thermodynamics, University of Bordeaux 1, 2003

4. O. Perrot, Thermodynamics Course, IUT of Saint-Omer, Dunkirk, 2011

5. C. L. Huillier, J. Rous, Introduction to Thermodynamics, Dunod Edition.

Semestre: 2
Unité d'enseignement: UEM 1.2
Matière 1: TP Physique 2
VHS: 45h00 (TP: 1h30)
Crédits: 2
Coefficient: 1

Objectifs de l'enseignement
Consolider à travers des séances de Travaux Pratiques les notions théoriques abordées dans le cours de Physique 2.

Connaissances préalables recommandées
Mathématiques 1, Physique 1.

Contenu de la matière:

5 manipulations au minimum (3h00 / 15 jours)

- Présentation des instruments et outils de mesure (Voltmètre, Ampèremètre, Rhéostat, Oscilloscopes, Générateur, etc.).
- Les lois de Kirchhoff (loi des mailles, loi des nœuds).
- Théorème de Thévenin.
- Association et Mesure des inductances et capacités
- Charge et décharge d'un condensateur
- Oscilloscope
- TP sur le magnétisme

Mode d'évaluation:
Contrôle continu: 100%

Semester: 2
Teachnig unit: UEM 1.2
Matter 2: TP Chemistry 2
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

Course Objectives

Consolidate the theoretical concepts covered in the Thermodynamics course through practical sessions.

Recommended Prior Knowledge

Thermodynamics.

Course Content:

1. Ideal Gas Laws.

2. Water Value of the Calorimeter.

3. Specific Heat: Specific heat of liquids and solids.

4. Latent Heat: Latent heat of fusion of ice.
5. Heat of Reaction: Determination of the energy released by a chemical reaction (HCl/NaOH).
6. Hess's Law.
7. Vapor Pressure of a Solution.

Assessment Method:

Continuous Assessment: 100%

Semester: 2
Teachnig unit: UEM 1.2
Matter 3: Informatique 2
VHS: 45h00 (Course: 1h30, TP: 1h30)
Credits: 4
Coefficient: 2

Course Objectives
Master basic programming and algorithmic techniques. Acquire fundamental computer science concepts. The skills to be acquired include: Programming with a certain degree of autonomy; Designing algorithms from the simplest to the relatively complex.

Recommended Prior Knowledge
Knowledge of using the university website, file systems, Windows user interface, and programming environment.

Course Content:

Chapter 1: Indexed Variables (4 Weeks)
1- One-Dimensional Arrays: Memory Representation, Array Operations
2- Two-Dimensional Arrays: Memory Representation, Operations on Two-Dimensional Arrays

Chapter 2: Functions and Procedures (6 Weeks)
1- Functions: Function Types, Function Declarations, Function Calls
2- Procedures: Concepts of Global and Local Variables, Simple Procedures, Procedures with Arguments

Chapter 3: Records and Files (5 Weeks)
1- Heterogeneous Data Structures
2- Record Structure (Concept of Fields)
3- Manipulating Record Structures
4- Concept of a File
5- File Access Modes
6- Reading and Writing to a File

Computer Lab 2:
Plan a number of labs to put the programming techniques covered in the course into practice.
- Practical work applying programming techniques covered in class.

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

Bibliographic references:
1- Algorithms for Dummies (large format) by John Paul Mueller (Informatiker, USA) and Luca Massaron, 2017
2- Algorithms: Course with 957 exercises and 158 problems (book by Charles E. Leiserson, Clifford Stein, and Thomas H. Cormen, 2017)
3- Algorithms: Basic Concepts (book by Thomas H. Cormen, 2013).

Semester: 2
Teaching unit: UEM 1.2
Matter 4: Presentation methodology
VHS: 15h00 (Course: 1h00)
Credits: 1
Coefficient: 1

Course Objectives
To provide the basics for a successful oral presentation. Skills to be acquired include: Knowing how to prepare a presentation; Knowing how to deliver a presentation; Knowing how to capture the audience's attention; Understanding the pitfalls of plagiarism and understanding intellectual property regulations.

Recommended Prior Knowledge
Expression and Communication Techniques and Writing Methodology.

Course Content:

Chapter 1: Oral Presentation (3 Weeks)
Communication. Preparing an Oral Presentation. Different Types of Outlines.

Chapter 2: Presenting an Oral Presentation (3 Weeks)
Structure of an Oral Presentation. Presenting an Oral Presentation.

Chapter 3: Plagiarism and Intellectual Property (3 Weeks)
1- Plagiarism: Definitions of plagiarism, penalties for plagiarism, how to borrow other authors' work, quotes, illustrations, how to be sure to avoid plagiarism. 2- Writing a Bibliography: Definition, Objectives, How to Present a Bibliography, and How to Write a Bibliography

Chapter 4: Presenting a Written Work (6 Weeks)
- Presenting a Written Work. Applications: Presenting an Oral Presentation.

Assessment Method:
Exam: 100%.

Bibliographic References:
1. M. Fayet, Methods of Written and Oral Communication, 3rd Edition, Dunod, 2008.
2. M. Kalika, Master's Thesis – Managing a Thesis, Writing a Report, Preparing a Defense, Dunod, 2016.
3. M. Greuter, Succeeding in Your Thesis and Internship Report, L'Etudiant, 2014
4. B. Grange, Succeeding in a Presentation: Preparing Powerful Slides and Communicating Effectively in Public. Eyrolles, 2009.
5. H. Biju-Duval, C. Delhay, Tous orateurs, Eyrolles, 2011.
6. C. Eberhardt, Practical work with PowerPoint. Creating and Layout Slides, Dunod, 2014.
7. F. Cartier, Written and Oral Communication, Edition GEP- Groupe Eyrolles, 2012.
8. L. Levasseur, 50 Exercises for Public Speaking, 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
Matter 1: Careers in Science and Technology 2
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Subject Objective:
Introduce the student, in the first phase, to all the fields covered by the Science and Technology field, and in the second phase, to a wide range of careers that these fields can lead to. In the same context, this subject introduces the student to the new challenges of sustainable development and the new careers that can arise from them.

Recommended Prior Knowledge:
None.

Subject Content:
1. Industrial Health and Safety (IHS) and Mining Engineering: (2 weeks)
- Definitions and areas of application (Safety of property and people, Environmental issues, Exploration and exploitation of mineral resources, etc.)
- Role of the specialist in these fields.

2. Climate Engineering and Transportation Engineering: (2 weeks)
- Definitions and areas of application (Air Conditioning, Smart Buildings, Transportation Safety, Traffic Management and Road, Air, and Naval Transportation, etc.)
- Role of the specialist in these areas.

3. Civil Engineering, Hydraulics, and Public Works: (2 weeks)
- Definitions and areas of application (Building Materials, Major Road and Rail Infrastructure, Bridges, Airports, Dams, Drinking Water Supply and Sanitation, Hydraulic Flow, Water Resource Management, Public Works and Regional Planning, Smart Cities, etc.)
- Role of the specialist in these areas.

4. Aeronautics, Mechanical Engineering, Maritime Engineering, and Metallurgy: (2 weeks)
- Definitions and areas of application (aeronautics, avionics, automotive industry, ports, dikes, industrial equipment production, steel industry, metal processing, etc.)
- Role of the specialist in these fields.

5. Approaches to Sustainable Production: (2 weeks)
Industrial Ecology, Remanufacturing, Ecodesign.

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 Business: (3 weeks)
Definition of the company as an economic entity (notions of profit, costs, performance) and social entity (notion of corporate social responsibility), Impact of economic activities on the environment (examples), Challenges/benefits of sustainable development for the company, Means of engaging in a sustainable development approach (e.g., ISO 14001 certification, labeling (e.g., energy labeling, Ecolabel, Organic/AB Label, FSC Label, etc.), strategic sustainable development plan, Global Reporting Initiative (GRI), etc.), World rankings of the most sustainable companies (Dow Jones Sustainable Index, Global 100, etc.), Case studies of successful/eco-responsible companies in the S&T sectors (e.g., SIEMENS, Cisco, Henkel AG & Co., TOTAL, Peugeot, Eni SPA, etc.).

Student's personal work for this subject:

- Group/pair work: Reading articles on sustainable development and/or reports from successful and sustainable companies and preparing summaries of the main actions undertaken in the field of sustainable development.

Examples of documents for reading and summarizing:

- Case studies of ONA and ENIEM: Kadri, Mouloud, 2009, Sustainable Development, Business and ISO 14001 Certification, Market and Organizations Vol. 1 (No. 8), pp. 201-215 (free online access: http://www.cairn.info/revue-marche-et-organisations-2009-1-page-201.htm)
- Mireille Chiroleu-Assouline. Sustainable Development Strategies of Companies. Ideas, The Review of Economic and Social Sciences, CNDP, 2006, pp. 32-39 (free online access: http://halshs.archives-ouvertes.fr/hal-00306217/document)
- Webpage on TOTAL's environmental and societal commitments: https://www.total.com/fr/engagement
- Sustainable mobility innovations of the PSA group: http://www.rapportannuel.groupe-psa.com/rapport-2015/engagements/dessolutions-innovantes-pour-des-transports-durables/

Assessment method:

100% exam

Bibliographic references:

1- V. Maymo and G. Murat, The Sustainable Development and CSR Toolbox - 53 tools and methods, Published by Dunod, 2017.
2- P. Jacquemot and V. Bedin, The Encyclopedic Dictionary of Development Sustainable Development, Published by: Sciences Humaines, 2017.
3- Y. Veyret, J. Jalta, and M. Hagnerelle, Sustainable Development: All the Challenges in 12 Lessons, Published by: Autrement, 2010.
4- L. Grisel and Ph. Osset, Life Cycle Assessment of a Product or Service: Applications and Practical Implementation, 2nd Edition: AFNOR, 2008.
5- Sh. Shaked, N. Jolliet-Gavin, P. Crettaz, M. Saadé-Sbeih, and O. Jolliet, Life Cycle Assessment: Understanding and Carrying Out an Ecological Assessment, 3rd Edition: PPUR, 2017.
6- G. Pitron and H. Védrine, The Rare Metals War: The Hidden Side of the Energy and Digital Transition, Published by: Liens qui libèrent, 2018.
7- Environmental and Sustainable Development Careers, Collection: Course, Edition: ONISEP, 2015.

Semester: 2
Teachnig unit: UET 1.2
Matter 1: French language 2
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:
This subject aims to develop the following four skills: Listening Comprehension, Reading Comprehension, Oral Expression, and Written Expression through reading and text study.

Recommended Prior Knowledge:
Basic French.

Subject Content:
Below, we offer a set of topics covering fundamental sciences, technology, economics, social issues, communication, sports, health, etc. The teacher can choose texts from this list to explore during the lesson. Otherwise, they are free to explore other topics of their choice. The texts can be taken from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular journals, books, websites, audio and video recordings, etc.
For each text, the teacher helps the student develop their linguistic skills: listening, comprehension, and oral and written expression. In addition, he must use this text to identify the grammatical structures that he will develop during the same course session. We recall here, for illustration purposes, a set of grammatical structures that can be developed as examples. Of course, it is not a question of developing them all or in the same way. Some can be recalled and others in great detail.

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 Stadium Violence Drugs: A Social Scourge Smoking Academic Failure The Algerian War Social Media China, an Economic Power Superconductivity Cryptocurrency Advertising Autism	The subjunctive. The conditional. The imperative. The past participle. The passive form. Possessive adjectives, possessive pronouns. Demonstratives, demonstrative pronouns. Expression of quantity (several, some, enough, much, more, less, as much, etc.). Numbers and measurements. The pronouns "who, that, where, whose." Subordinate preposition of time. Cause, consequence. Purpose, opposition, condition. Comparatives, superlatives….

Assessment Method:

Exam: 100%.

Bibliographic References:

1. M. Badefort, Objective: International French Test, Edulang, 2006.
2. O. Bertrand, I. Schaffner, Passing the TCF, Exercises and Training Activities, Les éditions de l'école polytechnique, 2009.
3. M. Boulares, J.-L. Frerot, Progressive French Grammar with 400 Exercises, Advanced Level, CLE International.
4. Collective, Besherelles: Grammar for Everyone, Hatier.
5. Collective, Besherelles: Conjugation for Everyone, Hatier. 6. M. Grégoire, Progressive French Grammar with 400 Exercises, Beginner Level, CLE International, 1997.
7. A. Hasni et al., Training for Teaching Science and Technology in Secondary Schools, University of Quebec Press, 2006.
8. J.-L. Lebrun, Practical Guide to Scientific Writing, EDP Sciences, 2007.
9. J.M. Robert, Difficulties with French, Hachette,
10. C. Tisset, Teaching French in Schools: Grammar, Spelling and Conjugation, Hachette Education, 2005.
11. J. Bossé-Andrieu, Summary of Grammar and Spelling Rules, University of Quebec Press, 2001.
12. J.-P. Colin, French Simply, Eyrolles, 2010.
13. Collective, French Assessment Test, Hachette, 2001.
14. Y. Delatour et al., Practical French Grammar in 80 Worksheets with Corrected Exercises, Hachette, 2000.
15. Ch. Descotes et al., The Exercise Book: French Expression for the Intermediate Level, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, On the Move, Heinle Cengage Learning, 2011.
17. J. Dubois et al., The Essentials – Spelling, Larousse, 2009.

Semester: 2
Teachnig unit: UET 1.2
Matter 1: English Language 2
VHS: 22h30 (Course: 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 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 also contain a terminology which means the translation of some words from English to French one. , 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
Matter 1: Mathématics 3
VHS: 67h30 (Course: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Course Objectives:
At 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 Prior Knowledge
Mathematics 1 and Mathematics 2

Course Content:

Chapter 1: Simple and Multiple Integrals (3 weeks)
1.1 Review of the Riemann integral and the calculus of antiderivatives. 1.2 Double and Triple Integrals.
1.3 Application to the calculation of areas, volumes, 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 Transform (3 weeks)
5.1 Definition and properties. 5.2 Application to solving differential equations.

Chapter 6: Laplace Transform (2 weeks)
6.1 Definition and properties. 6.2 Application to solving differential equations.

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

Bibliographic references:
1- F. Ayres Jr., Theory and Applications of Differential and Integral Calculus - 1175 corrected exercises, McGraw-Hill.
2- F. Ayres Jr., Theory and Applications of Differential Equations - 560 corrected exercises, McGraw-Hill.
3- J. Lelong-Ferrand, J.M. Arnaudiès, Mathematics Course - Differential Equations, Multiple Integrals, Volume 4, Dunod University.
4- M. Krasnov, Collection of Problems on Ordinary Differential Equations, Moscow Publishing House

5- N. Piskunov, Differential and Integral Calculus, Volume 1, Moscow Edition

6- J. Quinet, Elementary Course in Advanced Mathematics 3 - Integral Calculus and Series, Dunod.

7- J. Quinet, Elementary Course in Advanced Mathematics 4 - Differential Equations, Dunod.

8- M. R. Spiegel, Laplace Transforms, Course and Problems, 450 Corrected Exercises, McGraw-Hill.

Semester: 3
Teaching unit: UEF 2.1.1
Matter 2: Ondes et Vibrations
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:

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

Recommended Prior Knowledge

Mathematics 2, Physics 1 and Physics 2

Course Content:

Preamble: This subject is divided into two parts, the Waves part and the Vibrations part, which can be approached independently of each other. In this regard and due to the consistency of this subject in terms of content, it is advisable to approach this subject in this order: Waves and then Vibrations for students in the Electrical Engineering (Group A) streams. While for students in Groups B and C (Civil Engineering, Mechanical Engineering and Process Engineering), it is advisable to start with Vibrations. In any case, the teacher is called upon to do his best to cover both parts. We remind you that this subject is intended for engineering professions in the Science and Technology field. Also, the teacher is requested to skim over all parts of the course that require demonstrations or theoretical developments and to focus only on the applied aspects. Moreover, demonstrations can be the subject of an auxiliary work to be requested from students as activities within the framework of the student's personal work. For this purpose, consult paragraph "G- Student Assessment through Continuous Assessment and Personal Work" in this training offer.

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 Velocity-Dependent Frictional Forces
1.1.4 Case of a Time-Dependent External Force
1.2 System with Multiple Degrees of Freedom

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

2.1 Undamped Oscillations
2.2 Free Oscillations of Damped Systems

Chapter 3: Forced Oscillations of One-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 Two-Degree-of-Freedom Systems

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

5.1 Lagrange's Equations
5.2 Mass-Spring-Damper System
5.3 Impedance
5.4 Applications
5.5 Generalization to Systems with N Degrees of Freedom

Part B: Waves

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

1.1 Generalities and Basic Definitions
1.2 Propagation Equation
1.3 Solution to the Propagation Equation
1.4 Sinusoidal Traveling Wave
1.5 Superposition of Two Sinusoidal Traveling Waves

Chapter 2: Vibrating Strings (2 weeks)

2.1 Wave Equation
2.2 Harmonic Traveling Waves
2.3 Free Oscillations of a Finite-Length String
2.4 Reflection and Transmission

Chapter 3: Acoustic Waves in Fluids (1 week)

3.1 Wave Equation
3.2 Speed of Sound
3.3 Sinusoidal Traveling Wave
3.4 Reflection-Transmission

Chapter 4: Electromagnetic Waves (2 weeks)

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

Assessment Method:

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

Bibliographic References:

1. H. Djelouah; Mechanical Vibrations and Waves – Courses & Exercises (USTHB University website: perso.usthb.dz/~hdjelouah/Coursvom.html)

2. T. Becherrawy; Vibrations, Waves and Optics; Hermes Science Lavoisier, 2010

3. J. Brac; Propagation of Acoustic and Elastic Waves; Hermès Science Publ. Lavoisier, 2003.

4. R. Lefort; Waves and Vibrations; Dunod, 2017

5. J. Bruneaux; Vibrations, Waves; Ellipses, 2008.

6. J.-P. Perez, R. Carles, R. Fleckinger; Electromagnetism: Foundations and Applications, Dunod, 2011.

7. H. Djelouah; Electromagnetism; University Publications Office, 2011.

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

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

Recommended Prior Knowledge:
Basic knowledge of materials physics and fundamental electricity.

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

Chapter 1. Continuous System and Fundamental Theorems (3 weeks)
Definitions (dipole, branch, node, mesh), voltage and current generators (ideal, real), voltage-current relationships (R, L, C), voltage divider, current divider. Fundamental theorems: superposition, Thévenin, Norton, Millmann, Kennelly, Thévenin-Norton equivalence, Maximum Power Transfer Theorem.

Chapter 2. Passive Quadrupoles (3 weeks)
Representation of a passive network by a quadrupole. Quantities characterizing the behavior of a quadrupole in an assembly (input and output impedance, voltage and current gain), application to matching. Passive filters (low-pass, high-pass, etc.), gain curve, phase curve, cutoff frequency, bandwidth.

Chapter 3. Diodes (3 weeks)
Basic review of semiconductor physics: Definition of a semiconductor, crystalline Si, doping concepts, N and P semiconductors, PN junction, construction and operation of a diode, forward and reverse biases, current-voltage characteristics, static and variable regimes, equivalent circuit diagrams. Diode applications: half-wave and full-wave rectification. Voltage stabilization using a Zener diode. Clipping. Other types of diodes: varicap, LED, photodiode.

Chapter 4. Bipolar Transistors (3 weeks)
Bipolar Transistors: Transistor effect, operating modes (blocking, saturation, etc.), Static characteristic network, Polarizations, Load line, Quiescent point, etc. Study of the three fundamental circuits: EC, BC, CC, Equivalent circuit diagram, Voltage gain, Decibel gain, Bandwidth, Current gain, Input and output impedances. Study of multi-stage BF amplifiers in static and dynamic conditions, link capacitors, decoupling capacitors. Other uses of the transistor: Darlington circuit, switching transistor, etc.

Chapter 5 - Operational Amplifiers: 3 weeks
Principle, Equivalent Circuit Diagram, Ideal Op-Amp, Feedback, Op-Amp Characteristics, Basic Operational Amplifier Circuits: Inverting, Non-Inverting, Adder, Subtractor, Comparator, Follower, Differentiator, Integrator, Logarithmic, Exponential, **etc.**

Assessment Method:

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

Bibliographic References:

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

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

Course Objectives:

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

Recommended Prior Knowledge:

Fundamentals of electricity.

Course Content:

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

Cartesian Form, Conjugate CNs, Modulus, Arithmetic Operations on CNs (addition, etc.), Geometric Representation, Trigonometric Form, de Moivre Formula, Root of CNs, Exponential Representation of a CN, Trigonometric Application of Euler's Formulas, Application of CNs to Electricity.

Chapter 2. Review of the Fundamental Laws of Electricity (2 Weeks)

Continuous System: Electric dipole, combination of R, C, and L dipoles.

Harmonic System: Representation of sinusoidal quantities, mean and effective values, Fresnel representation, complex notation, impedances, powers in sinusoidal systems (instantaneous, active, apparent, reactive), Boucherot's Theorem.

Transient System: RL circuit, RC circuit, RLC circuit, capacitor charging and discharging.

Chapter 3. Electrical Circuits and Power (3 Weeks)

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

Chapter 4. Magnetic Circuits (3 Weeks)

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

Chapter 5. Transformers (3 Weeks)

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

Chapter 6. Introduction to Electrical Machines (3 Weeks)

General information on electrical machines. Operating principle of generators and motors. Power balance and efficiency.

Assessment method:

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

Bibliographic references:

(Depending on the availability of documentation at the institution, websites, etc.)
1. J.P. Perez, Electromagnetism: Foundations and Applications, 3rd Edition, 1997.
2. A. Fouillé, Electrotechnics for Engineers, 10th Edition, Dunod, 1980.
3. C. François, Electrical Engineering, Ellipses, 2004
4. L. Lasne, Electrotechnics, Dunod, 2008
5. J. Edminister, Theory and Applications of Electrical Circuits, McGraw Hill, 1972
6. D. Hong, Electrical Circuits and Measurements, Dunod, 2009
7. M. Kostenko, Electrical Machines - Volume 1, Volume 2, MIR Publishing, Moscow, 1979.
8. M. Jufer, Electromechanics, Polytechnic Press and French-speaking universities - Lausanne, 2004.
9. A. Fitzgerald, Electric Machinery, McGraw-Hill Higher Education, 2003.
10. J. Lesenne, Advanced Introduction to Electrical Engineering. Technique and Documentation, 1981.
11. P. Maye, Industrial Electric Motors, Dunod, 2005.
12. S. Nassar, Electrical Circuits, Maxi Schaum.

Semester: 3
Teaching unit: UEM2.1
Matter 1: Probability and statistics
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Subject Objectives

This module introduces students to the essential concepts of probability and statistics, namely: one- and two-variable statistical series, probability in a finite universe, and random variables.

Recommended Prior Knowledge

Mathematics 1 and Mathematics 2

Subject Content:

Part A: Statistics

Chapter 1: Basic Definitions (1 week)

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

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

A.2.1 Frequency, Frequency, Percentage
A.2.2 Cumulative Frequency, Cumulative Frequency
A.2.3 Graphical Representations: Bar Chart, Pie Chart, Bar Chart. Frequency (and Frequency) Polygon. Histogram. Cumulative Curves
A.2.4 Positional Characteristics
A.2.5 Dispersion Characteristics: Range, Variance and Standard Deviation, Coefficient of Variation
A.2.6 Shape Characteristics

Chapter 3: Bivariate Statistical Series (3 Weeks)

A.3.1 Data Tables (Contingency Table). Scatter Plots
A.3.2 Marginal and Conditional Distributions. Covariance
A.3.3 Linear Correlation Coefficient. Regression Line and Mayer Line
A.3.4 Regression Curves, Correlation Correlation, and Correlation Ratio
A.3.5 Functional Adjustment

Part B: Probability

Chapter 1: Combinatorial Analysis (1 Week)

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

Chapter 2: Introduction to Probability (2 weeks)

B.2.1 Algebra of Events
B.2.2 Definitions

B.2.3 Probability 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 Distribution Function,
B.4.3 Expected Value,
B.4.4 Covariance and Moments.

Chapter 5: Common Discrete and Continuous Probability Distributions (3 weeks)
Bernoulli, Binomial, Poisson, ...; Uniform, Normal, Exponential, ...

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

Bibliographic references:
1. D. Dacunha-Castelle and M. Duflo. Probability and Statistics: Fixed-Time Problems. Masson, 1982.
2. J.-F. Delmas. Introduction to Probability Calculus and Statistics. ENSTA handout, 2008.
3. W. Feller. An Introduction to Probability Theory and its Applications, Volume 1. Wiley & Sons, Inc., 3rd edition, 1968.
4. G. Grimmett, D. Stirzaker, Probability and Random Processes, Oxford University Press, 2nd edition, 1992.
5. J. Jacod and P. Protter, Probability Essentials, Springer, 2000.
6. A. Montfort. Course in Mathematical Statistics. Economica, 1988.
7. A. Montfort. Introduction to Statistics. Polytechnic School, 1991

Semester: 3
Teaching unit: UEM2.1
Matter 2: Computer Science 3
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

Subject Objectives:
To teach students programming using easily accessible software (primarily Matlab, Scilab, Mapple, etc.). This subject will be used as a tool for completing numerical methods labs in Year 4.

Recommended Prior Knowledge:
The fundamentals of programming acquired in Computer Science 1 and 2.

Subject Content:

Laboratory 1: Introduction to a Scientific Programming Environment (1 Week)
(Matlab, Scilab, etc.)
Laboratory 2: Script Files and Data and Variable Types (2 Weeks)
Laboratory 3: Reading, Displaying, and Saving Data (2 Weeks)
Laboratory 4: Vectors and Matrices (2 Weeks)
Laboratory 5: Control Statements (For and While Loops, If and Switch Statements) (2 Weeks)
Laboratory 6: Function Files (2 Weeks)
Laboratory 7: Graphics (Managing Graphics Windows, Plotting) (2 Weeks)
Laboratory 8: Using Toolboxes (2 Weeks)

Assessment Method:
Continuous Assessment: 100%.

Bibliographic references:
1. Jean-Pierre Grenier, Getting Started in Algorithms with MATLAB and SCILAB, Ellipses, 2007.
2. Laurent Berger, Scilab from Theory to Practice, 2014.
3. Bégyn Arnaud, Gras Hervé, Grenier Jean-Pierre, Programming and Simulation in Scilab, 2014.
4. Thierry Audibert, Amar Oussalah, Maurice Nivat, Computer Science: Programming and Scientific Computing in Python and Scilab for 1st and 2nd Year Scientific Preparatory Classes, Ellipses, 2010.

Semester: 3
Teaching unit: UEM 2.1
Matter 3: TP Electronics and Electrotechnical
VHS: 22h30 (TP: 1h30)
Crédits: 2
Coefficient: 1

Teaching Objectives:

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

Recommended Prior Knowledge

Fundamental Electronics. Fundamental Electrical Engineering .

Subject Content:

The practical instructor is required to complete at least 3 Electronics practical exercises and 3 Electrical Engineering practical exercises from the list below:

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

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

Assessment Method:

Continuous Assessment: 100%

Bibliographic references:

Semester: 3
Teaching unit: UEM 2.1
Matter 4: TP Wves et vibrations
VHS: 15h00 (TP: 1h00)
Credits: 1
Coefficient: 1

Teaching Objectives:

Les objectifs assignés par ce programme portent sur l'initiation des étudiants à mettre en pratique les connaissances reçues sur les phénomènes de vibrations mécaniques restreintes aux oscillations de faible amplitude pour un ou deux degrés de liberté ainsi que la propagation des ondes mécaniques.

Recommended Prior Knowledge

Vibrations et ondes, Mathématiques 2, Physique 1, Physique 2.

Subject Content:

TP1 : Masse – ressort
TP2 : Pendule simple
TP3 : Pendule de torsion
TP4 : Circuit électrique oscillant en régime libre et forcé
TP5 : Pendules couplés
TP6 : Oscillations transversales dans les cordes vibrantes
TP7 : Poulie à gorge selon Hoffmann
TP8 : Systèmes électromécaniques (Le haut parleur électrodynamique)
TP9 : Le pendule de Pohl
TP10 : Propagation d'ondes longitudinales dans un fluide.

Remarque : Il est recommandé de choisir au moins 5 TP parmi les 10 proposés.

Assessment Method:

Continuous Assessment: 100%

Bibliographic references:

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

Teaching Objectives:

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

Recommended Prior Knowledge

None

Subject Content :

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

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

Assessment method: Final exam: 100%.

Bibliographic references:
(Depending on the availability of documentation at the institution, websites, etc.)

Semester: 3
Teaching unit: UED 2.1
Matter 2: Energy and environment
VHS: 22h30 (Cours: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

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

Recommended Prior Knowledge

Concepts of energy and environment.

Subject Content :

Chapter 1: Different Energy Resources

Chapter 2: Energy Storage

Chapter 3: Consumption, Reserves, and Trends in 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 al., Electrotechnics of Renewable Energies and Cogeneration, Dunod, 2008
2- Pinard, Renewable Energies for Electricity Production, Dunod, 2009
3- Crastan, Power Plants and Alternative Electricity Production, Lavoisier, 2009
4- Labouret and Villoz, Photovoltaic Solar Energy, 4th ed., Dunod, 2009-10.

Semestre: 3
Teaching unit : UET 2.1
Matter 1: Technical English
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:
This course should enable students to acquire a sufficiently significant level of language proficiency to use a scientific document and discuss their specialty and field of study in English, at least with a certain fluency and clarity.

Recommended Prior Knowledge:
English 1 and English 2

Subject Content:

- Listening and speaking comprehension, vocabulary acquisition, grammar, etc.
- Nouns and adjectives, comparatives, following and giving instructions, identifying objects.
- Use of numbers, symbols, and equations.
- Measurements: Length, surface area, volume, power, etc.
- Describing scientific experiments.
- Characteristics of scientific texts.

Assessment Method:
Final Exam: 100%.

Bibliographic References:

1. J. Upjohn, S. Blattes, V. Jans, Minimum Competence in Scientific English, Office of University Publications, 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.

Semestre: 4
Teaching unit : UEF 2.2.1
Matière 1: Fundamental electrotechnical 2
VHS: 67h30 (Course: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Course Objectives

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

Recommended Prior Knowledge

Fundamental Electrical Engineering 1

Course Content:

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

Chapter 2: Transformer (4 weeks)

General Information, Operating Principle of the Single-Phase Transformer, The Ideal Transformer, Calculating Induced Electromotive Force, Impedance Matching, The Real Transformer, The Transformer in the Kapp Approximation, Evaluation of Secondary Voltage Drop, Energy Balance and Efficiency, Measurements for Efficiency Calculation, Three-Phase Transformer, Different Types of Coupling and Hourly Rate.

Chapter 3: Direct Current Machines (4 weeks)

General Information, Operating Principle – Construction, Direct Current Generator – Characteristic Equations, Calculation of Electromotive Force and Torque, Different Excitation Modes, Direct Current Motor – Operating Principle, Energy Balance, and Efficiency.

Chapter 4: Synchronous Machines (3 weeks)

General Information, Concept of Rotating Field, Operating Principle – Construction 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)

Operating Principle – Construction of Asynchronous Machines, Equations and Equivalent Single-Phase Diagram, Torque and Mechanical Characteristics, Energy Balance and Efficiency, Simplified Circle Diagram.

Assessment Method:

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

Bibliographic references:

1. Jacques Lesenne, Francis Notelet, and Guy Séguier, Introduction to Advanced Electrical Engineering, Technique et Documentation, 1981.
2. Pierre Maye, Industrial Electric Motors, Dunod, 2005.
3. R. Annequin and J. Boutigny, Physical Sciences Course, Electricity 3, Vuibert.

4. M. Kouznetsov, Foundations of Electrical Engineering. 5. H. Lumbroso, Solved Problems on Electrical Circuits, Dunod. 6. J.P. Perez, R. Carles, and R. Fleekinger, Electromagnetism: Fundamentals and Applications, 3rd Edition, 1997.
7. A. Fouillé, Electrical Engineering for Engineers, Dunold, 1963.
8. M. Kostenko, L. Piotrovski, Electrical Machines - Volume 1, Volume 2, MIR Publishing, Moscow, 1979.
9. Marcel Jufer, Electromechanics, Presses Polytechniques et Universitaires Romandes-Lausanne, 2004.
10. A. E. Fitzgerald, Charles Kingsley Jr., and Stephen D. Umans, Electric Machinery, McGraw-Hill Higher Education, 2003.
11. Edminster, Theory and Applications of Electrical Circuits, McGraw-Hill.

Semester: 4
Teaching unit: UEF 2.2.1
Matter 2: Combinatorial and sequential logic
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:

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

Recommended Prior Knowledge

None.

Course Content:

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

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

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

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

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

Chapter 3: Combinational Transcoder Circuits (2 weeks)

Definitions, decoders, priority encoders, transcoders, cascading, applications, analysis of the datasheet of a decoder integrated circuit, list of decoder integrated circuits.

Chapter 4: Combinational Switch Circuits (2 weeks)

Definitions: multiplexers, demultiplexers, cascading, applications, analysis of a switching integrated circuit datasheet, list of integrated circuits.

Chapter 5: Combinational Comparison Circuits (2 weeks)

Definitions: 1-bit, 2-bit, and 4-bit comparison circuits, cascading, applications, analysis of a comparison integrated circuit datasheet, list of integrated circuits.

Chapter 6: Flip-Flops (2 weeks)

Introduction to sequential circuits. The RS flip-flop, the RST flip-flop, the D flip-flop, the master-slave flip-flop, the T flip-flop, the JK flip-flop. Examples of flip-flop applications: Frequency divider by n, Pulse train generator, etc.

For each flip-flop, it is recommended to present the truth table, examples of timing diagrams, as well as the limitations and imperfections.

Chapter 7: Counters (2 weeks)

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

Chapter 8. Registers (1 week)

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

Assessment method:

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

Bibliographic references:

1- J. Letocha, Introduction to Logic Circuits, McGraw Hill Publishing.

2- J.C. Lafont, Courses and Problems in Digital Electronics, 124 Exercises with Solutions, Ellipses.

3- R. Delsol, Digital Electronics, Volumes 1 and 2, Berti Publishing.

4- P. Cabanis, Digital Electronics, Dunod Publishing.

5- M. Gindre, Combinatorial Logic, Ediscience Publishing.

6- H. Curry, Combinatory Logic II. North-Holland, 1972.

7- R. Katz, Contemporary Logic Design, 2nd ed. Prentice Hall, 2005.

8- M. Gindre, Digital Electronics: Combinatorial Logic and Technology, McGraw Hill, 1987

9- C. Brie, Combinatorial and Sequential Logic, Ellipses, 2002.

10- J-P. Ginisti, Combinatorial Logic, Paris, PUF (coll. "Que sais-je?" no. 3205), 1997.

11- J-L. Krivine, Lambda Calculus, Types and Models, Masson, 1990, chap. Combinatorial Logic, English translation available on the author's website.

Semester: 4
Teaching unit: UEF 2.2.2
Matter 1: Numerical methods
VHS: 45h00 (Cours: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:

Familiarization with numerical methods and their applications in mathematical calculations.

Recommended Prior Knowledge:

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

Course Content:

Chapter 1. Solving Nonlinear Equations f(x)=0 (3 Weeks)

1. Introduction to Computational Errors and Approximations, 2. Introduction to Methods for Solving Nonlinear Equations, 3. Bisection Method, 4. Method of Successive Approximations (Fixed Point), 5. Newton-Raphson Method.

Chapter 2. Polynomial Interpolation (2 Weeks)

1. General Introduction, 2. Lagrange Polynomial, 3. Newton Polynomials.

Chapter 3. Function Approximation: (2 Weeks)

1. Approximation Method and Root Mean Square. 2. Orthogonal or Pseudo-Orthogonal Systems. Approximation by Orthogonal Polynomials, 3. Trigonometric Approximation.

Chapter 4. Numerical Integration (2 Weeks)

1. General Introduction, 2. Trapezoid Method, 3. Simpson's Method, 4. Quadrature Formulas.

Chapter 5. Solving Ordinary Differential Equations

(Initial Condition or Cauchy Problem) (2 Weeks)

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

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

1. Introduction and Definitions, 2. Gaussian Method and Pivoting, 3. LU Factorization Method, 4. Choeleski Factorization Method (MMt), 5. Thomas Algorithm (TDMA) for Tri-Diagonal Systems.

Chapter 7. Approximate Solution Method for Systems of Linear Equations

(2 Weeks)

1. Introduction and Definitions, 2. Jacobi Method, 3. Gauss-Seidel Method, 4. Use of Relaxation.

Assessment Method:

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

Bibliographic references:

1. C. Brezinski, Introduction to the Practice of Numerical Calculation, Dunod, Paris 1988.

2. G. Allaire and S.M. Kaber, Numerical Linear Algebra, Ellipses, 2002.

3. G. Allaire and S.M. Kaber, Introduction to Scilab. Corrected Practical Exercises in Linear Algebra, Ellipses, 2002.

4. G. Christol, A. Cot, and C.-M. Marle, Differential Calculus, Ellipses, 1996.

5. M. Crouzeix and A.-L. Mignot, Numerical Analysis of Differential Equations, Masson, 1983.

6. S. Delabrière and M. Postel, Approximation Methods. Differential Equations. Scilab Applications, Ellipses, 2004.

7. J.-P. Demailly, Numerical Analysis and Differential Equations. Grenoble University Press, 1996.

8. E. Hairer, S. P. Norsett, and G. Wanner, Solving Ordinary Differential Equations, Springer, 1993.

9. P. G. Ciarlet, Introduction to Numerical Matrix Analysis and Optimization, Masson, Paris, 1982.

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

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

Recommended prior knowledge:
Basic mathematics course.
Course Content:
Chapter 1. General Information on Signals (3 Weeks)
Objectives of signal processing. Areas of application. Signal classification (morphological, spectral, etc.). Deterministic signals (periodic and non-periodic) and random signals (stationary and non-stationary). Causality. Concepts of power and energy. Basic functions in signal processing (measurement, filtering, smoothing, modulation, detection, etc.). Examples of basic signals (rectangular pulse, triangular pulse, ramp, step, sign, Dirac, etc.)

Chapter 2. Fourier Analysis (4 Weeks)
Introduction, Mathematical Review (dot product, Euclidean distance, linear combination, orthogonal basis, etc.). Approximation of signals by a linear combination of orthogonal functions. Fourier Series, Fourier Transform, Properties. Parseval's Theorem. Fourier spectrum of periodic (discrete spectrum) and non-periodic (continuous spectrum) signals.

Chapter 3. Laplace Transform (3 Weeks)
Definition. Properties of the Laplace Transform. Signal/System Relationship. Application to linear and translation-invariant systems or SLIT (Time and Frequency Analysis).

Chapter 4. Convolution Product (2 Weeks)
Formulation of the convolution product, Properties of the convolution product, Convolution product and Dirac momentum.

Chapter 5. Signal Correlation (3 Weeks)
Signals with finite total energy. Signals with finite total average power. Cross-correlation between signals, autocorrelation, properties of the correlation function. Energy spectral density and power spectral density. Wiener-Khintchine theorem. Case of periodic signals.

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

Bibliographic references:
1. S. Haykin, "Signals and Systems," John Wiley & Sons, 2nd ed., 2003.
2. A.V. Oppenheim, "Signals and Systems," Prentice-Hall, 2004.
3. F. de Coulon, "Signal Theory and Processing," PPUR Edition.
4. F. Cottet, "Signal Processing and Data Acquisition, Courses and Solved Exercises," Dunod.
5. B. Picinbono, "Signal and Systems Theory with Solved Problems," Bordas Edition.
6. M. Benidir, "Signal Theory and Processing, Volume 1: Representation of Signals and Systems - Course and Corrected Exercises", Dunod, 2004.
7. M. Benidir, "Signal Theory and Processing, Volume 2: Basic Methods for Signal Analysis and Processing - Course and Corrected Exercises", Dunod, 2004.
8. J. Max, Traitement du signal

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

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

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

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

Chapter 1. Measurements, Quantities, and Uncertainties (5 weeks)
Introduction, Quantity, Standard, Unit Systems, Table of Multiples and Submultiples, Dimensional Equations, Useful Formulas, Measurement Accuracy, Measurement Error, Classification of Errors, Uncertainties in Indirect Measurements, Qualities of Measuring Instruments, Calibration of Measuring Instruments, Graphic Symbols of Measuring Instruments, General Measurement Methods (Deflection, Zero, and Resonance Methods), Application Exercises.

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

Chapter 3. Measuring Devices (4 weeks)
Introduction

Analog Measuring Devices: Classification of Deflection Devices, Moving Coil Galvanometer, Structure of the Magnetoelectric Ammeter, Structure of the Magnetoelectric Voltmeter, Operation of the Electrodynamic Wattmeter in AC Power
Digital Measuring Devices: Analog-to-Digital Converters (ADCs), Operating Principle of a Digital Measuring Device, Examples of Digital Measuring Devices (Multimeter, Oscilloscope, etc.).

Electrical and Electronic Measurements Lab:

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

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

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

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

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

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

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

Bibliographic references:

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

Internet sources:

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

Semester: 4
Teaching unit: UEM 2.2
Matter 2: TP Fundamental electrotechnical 2
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

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

Recommended Prior Knowledge
Fundamental Electrical Engineering 2.

Subject Content:

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

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

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

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

Lab No. 5 Load Characteristics of an Asynchronous Motor

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

Lab No. 7 Alternator - Functional Diagram –

Assessment Method:
Continuous Testing: 100%.

Bibliographic References:
(Books and handouts, websites, etc.)

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

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

Recommended Prior Knowledge:
Combinational and Sequential Logic.

Subject Content:

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

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

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

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

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

Exercise 5: Study and implementation of a combinational logic circuit
Implementation of a logic function using logic gates. Example: a 7-segment display and/or a 2's complement generator for a 4-bit number and/or a 4-bit Gray code generator, etc.

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

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

Laboratory work 8: Study and implementation of registers

Assessment Method:
Continuous Testing: 100%.

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

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

Semester: 4
Teaching unit : UEM 2.2
Matter 4: TP Méthodes numériques
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

Course Objectives

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

Recommended prior knowledge

Numerical Method, Computer Science 2, and Computer Science 3.

Course Content:

Chapter 1: Solving Nonlinear Equations (3 weeks)

1. Bisection Method. 2. Fixed Point Method, 3. Newton-Raphson Method

Chapter 2: Interpolation and Approximation (3 weeks)

1. Newton Interpolation, 2. Chebyshev Approximation

Chapter 3: Numerical Integration (3 weeks)

1. Rectangle Method, 2. Trapezoid Method, 3. Simpson Method

Chapter 4: Differential Equations (2 weeks)

1. Euler Method, 2. Runge-Kutta Methods

Chapter 5: Systems of Linear Equations (4 weeks)

1. Gauss-Jordon Method, 2. Crout Decomposition and LU Factorization, 3. Jacobi Method, 4. Gauss-Seidel Method
2.

Assessment Method:

Continuous Testing: 100%.

Bibliographic references:

1. José Ouin, Algorithmics and Numerical Calculation: Solved Practical Assignments and Programming with Scilab and Python Software, Ellipses, 2013.
2. Bouchaib Radi, Abdelkhalak El Hami, Mathematics with Scilab: Guide to Calculation, Programming, and Graphical Representations; Compliant with the New MPSI Program, Ellipses, 2015.
3. Jean-Philippe Grivet, Applied Numerical Methods: for Scientists and Engineers, EDP Sciences, 2009.

Semester: 4
Teaching unit : UED2.2
Matter 1: Production de l'énergie électrique
VHS: 22h30 (Cours: 1h30)
Credits: 1
Coefficient: 1

Course Objectives

Understand, master, and acquire the basic principles of the different modes of electrical energy production. Upon completion of this course, students should be aware of energy issues in general and the impact of electrical energy on socioeconomic life in particular.

Recommended Prior Knowledge:
A basic understanding of thermodynamics and fluid mechanics, and especially a basic understanding of fundamental electrical engineering (electricity and circuits, electric and magnetic fields, power, three-phase system, alternator, motor, transformer).

Course Content:
Chapter 1. General Information (2 weeks)
History of electricity production. History of the evolution of electrical energy production in Algeria. Eco-design and sustainable development, renewable and non-renewable energies, economic aspects.

Chapter 2. Thermal Power Plants (2 weeks)

Chapter 3. Generators (2 weeks)

Chapter 4. Nuclear Power Plants (2 weeks)

Chapter 5. Hydroelectric Power Plants (2 weeks)

Chapter 6. Wind Energy (2 weeks)
Aerodynamics and types of wind turbines, operating principle, grid interface, protection, and voltage regulation.

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

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

Assessment Method:
Exam: 100%.

Bibliographic references:

1. Jean Claude Sabonnadière, New Energy Technologies 1: Renewable Energies, Hermès Publishing.
2. Paul Gide, The Big Book of Wind Power, Moniteur Publishing.
3. A. Labouret, Photovoltaic Solar Energy, Dunod Publishing.
4. Pierre Louis Viollet, History of Hydraulic Energy, ENP Chaussée Publishing.
5. Felix A. Peser, Solar Thermal Installations: Design and Implementation, Moniteur Publishing, Dunod/L'Usine Nouvelle, 2013.
6. B. Robyns et al., Electricity Production from Renewable Sources (Electric Energy Sciences and Technologies Collection), Lavoisier, 2012.

1. 7. G. Laval, Nuclear Fusion: From Basic Research to Energy Production?, EDP Sciences, 2007.V. Crastan, Centrales électriques et production alternative d'électricité, Hermès-Lavoisier, 2009.

Semester: 4
Teaching unit: UED2.2
Matière 2: Sécurité électrique
VHS: 22h30 (Cours: 1h30)
Crédits: 1
Coefficient: 1

Course Objectives

The objective of this course is to inform the future graduate about the nature of electrical accidents, emergency response methods for electrical accidents, and to provide them with sufficient knowledge to optimally size protective devices for equipment and personnel working in industry and other areas where this equipment is used.

Recommended Prior Knowledge:

Basic knowledge of electricity.

Course Content:

Chapter 1: Electrical Hazards (2 weeks)

Definition and purpose of occupational safety, Legend and history of electrical hazards, Standardization body, 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 of influence of human current, Pathophysiological effects of electric current, Electrocution without loss of consciousness, Electrocution with loss of consciousness (ventricular fibrillation).

Chapter 3: Protective Measures (6 weeks)

Introduction, Personal Protection, Regulations, Safety Measures, Live Working, Working Near Electrical Installations, Individual and Collective Protection, Protection Against Direct and Indirect Currents, Safety Voltage, Earthing System (Earthing System), Effects of Electric and Magnetic Fields, Equipment Protection, Protective Devices (Types and Reliability of Devices), LV, MV, and HV Indoor Installations, LV Mobile Devices, Checks and Inspections.

Chapter 4: Safety Measures Against the Indirect Effects of Electric Current (2 weeks)

Fires, Harmful Materials, Explosions, Noise and Vibration (Definition, Standards, and Noise Control Techniques).

Chapter 5: Emergency Measures and Care (2 weeks)

Attitude to Observe in the Event of Electrical Accidents, First Aid, Assisted Ventilation (Mouth-to-Mouth and Sylvester Methods), External Cardiac Massage, Burn Care.

Assessment Method:

Final Exam: 100%.

Bibliographic references:

1- V. Semeneko, General Requirements for Technical Safety in a Company, University of Annaba, 1979.
2- A. Novikov, Workplace Safety Coursebook, University of Annaba, 1983.
3- Edgar Gillon, Electrical Engineering Course, Dunod, Paris 1966.
4- Encyclopedia of Industrial Sciences, Quillet, Paris, 1983.
5- L.G. Hewitson, Guide to the Protection of Electrical Equipment, Dunod, 2007.

Semester:4
Teaching unit: UET2.2
Matter : Techniques of expression, information and communication
VHS:22h30 (Course: 1h30)
Credits:1
Coefficient:1

Course Objectives:

This course aims to develop the student's personal and professional skills in the areas of communication and expression techniques. It also provides students with an understanding of the techniques, tools, and methods used to facilitate communication.

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

Course Content:

Chapter 1: Researching, Analyzing, and Organizing Information (2 weeks)
Identifying and Using Documentary Locations, Tools, and Resources, Understanding and Analyzing Documents, Compiling and Updating Documentation.

Chapter 2: Improving Expression Skills (2 weeks)
Taking into Account the Communication Situation, Producing a Written Message, Communicating Orally, Producing a Visual and Audiovisual Message, and Improving Group Communication Skills.

Chapter 3: Developing Autonomy, Organizational, and Communication Skills within a Project Approach (2 weeks)
Identifying Oneself in a Project and Communication Approach, Anticipating Action, Implementing a Project: Presentation of a Report on a Practical Assignment (Homework).

Chapter 4: ICT - Definition and Evolution (2 weeks)
Definition, Activities Using ICT, Mastering ICT Skills, Evolution of ICT, Information and Communication Services

Chapter 5: Searching, Using, and Retrieving Information (2 weeks)
Search Directories (YAHOO, GOOGLE), Search Engines, Query and Search Language, Retrieving and Printing an HTML Page, Retrieving an Image, Downloading a File or Software, Playing an HTML File Locally, Playing a Multimedia File Saved on the Web.

Chapter 6: ICT Law (2 weeks)
Computer Crime, Media Law, Electronic Communications Law, E-Commerce Law, Internet Governance, etc.

Chapter 7: Securing Sensitive Information, Protecting Confidential Data, and Preventing Harmful Content. (3 weeks)
Backing Up Important Data, the "Informatique et Libertés" Law, Internet Dangers, Computer Hacking, Machine Protection, Virus Protection, 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, Hoaxes, Cryptology, Electronic Signatures, etc.

Assessment Method:
Final exam: 100 %.

Bibliographic references:
(Books and handouts, websites, etc.)

1. Jean-Denis Commeignes, 12 Methods of Written and Oral Communication – 4th Edition, Michelle Fayet and Dunod 2013.
2. Denis Baril, Sirey, Techniques of Written and Oral Expression, 2008.
3. Matthieu Dubost, Improving Your Written and Oral Expression: All the Keys, Edition Ellipses 2014.
4. Allegrezza Serge and Dubrocard Anne (edited by). Internet Econometrics. Palgrave Macmillan Ltd, 2011. ISBN-10: 0230362923; ISBN-13: 9780230362925
5. Anduiza Eva, Jensen J. Michael, and Jorba Laja (edited by). Digital Media and Political Engagement Worldwide. Cambridge University Press - M.U.A, 2012. ISBN-10: 1107668492; ISBN-13: 9781107668492
6. Baron G.L., and Bruillard E. Computers and Their Users in Education. Paris, PUF, 1996. ISBN-10: 2130474926; ISBN-13: 978-2130474920
7. Chantepie P. and Le Diberder A. Digital Revolution and Cultural Industries. 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. How Digital Technology Transforms Knowledge Centers. 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. The Appropriation of Digital Training Devices. From Prescription to Use. 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
Matter 1: Electrical Networks
VHS: 67h30 (Course: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

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

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

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

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

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

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

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

Références:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Semestre: 5
Unité d'enseignement: UEF 3.1.1
Matière 2: Electronique de puissance
VHS: 45h00 (Cours: 1h30, TD: 1h30)
Crédits: 4
Coefficient: 2

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

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

Course Content :

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

Chapter 1. Introduction to Power Electronics (3 weeks)
Introduction to power electronics, its role in electrical energy conversion systems. Introduction to static converters. Classification of static converters (by switching mode, by conversion mode). Non-sinusoidal periodic quantities (rms values, average values, form factor, ripple rate).

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

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

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

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

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

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

3. J. Laroche, "Power Electronics - Converters: Courses and Corrected Exercises", Dunod, 2005.
4. G. Séguier et al. "Power Electronics: Courses and Corrected Exercises", 8th edition; Dunod, 2004.
5. D. Jacob, "Power Electronics - Principle of Operation, Dimensioning", Ellipses Marketing, 2008.
6. G. Séguier, "Power Electronics, Basic Functions and Their Main Applications", Tech et Doc.
7. H. Buhler, "Power Electronics", Dunod
8. C.W. Lander, "Power Electronics", McGraw-Hill, 1981
9. H. Buhler, "Control and Regulation Electronics; A Treatise on Electricity". 10. F. Mazda, “Power Electronics Handbook: Components, Circuits and Application,” 3rd Edition, Newness, 1997.
11. R. Chauprade, “AC Motor Controls (Power Electronics),” 1987.
12. R. Chauprade, “DC Motor Controls (Power Electronics),” 1984.

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

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

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

Course Content:

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

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

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

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

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

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

Bibliographic references:

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

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

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

Course Objectives:

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

Recommended Prior Knowledge:

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

Course Content:

Chapter 0: Vector Concepts: (1 Week)

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

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

Chapter 2. Magnetostatics: (3 Weeks)

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

Chapter 3. Variable Regime: (3 Weeks)

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

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

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

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

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

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

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

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

Course Objectives:

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

Recommended Prior Knowledge:

Basic concepts of electricity, electrostatics, and magnetostatics.

Course Content:

Chapter I: Electrical Equipment

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

Chapter II: Developing Electrical Diagrams

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

Chapter III. Lighting Circuits

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

Chapter IV. Three Modes of Controlling an Electric Motor

IV.1. Direct-on-Line Starting with a Single Direction of Rotation
IV.2. Direct-on-Line Motor Starting with a Dual Direction of Rotation
IV.3. Star-Delta Starting

Practical Activities

Laboratory Work 1: Main lighting assemblies:

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

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

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

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

Laboratory Work 4: Starting a two-way induction motor

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

Assessment Method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

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

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

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

Recommended Prior Knowledge:
Basic electrical engineering.

Subject Content:

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

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

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

Laboratory Work 4: Parallel Operation of Transformers.

Assessment Method:
Continuous Assessment: 100%.

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

Semester: 5
Teaching unit: UEM 3.1
Matter 3: TP Power electronics
VHS: 22h30 (TP: 1h30)
Credits: 2
Coefficient: 1

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

Recommended Prior Knowledge:
Basic electrical and electronic circuits.

Course Content:

Laboratory 1: Switching Components (IGBT, MOS).

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

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

Laboratory 4: Chopper.

Laboratory 5: Single-Phase Inverter.

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

Laboratory 7: Three-Phase Dimmer.

Assessment Method:
Continuous Assessment: 100%.

References:

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

Course Objectives:

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

Recommended Prior Knowledge:

Control Systems.

Course Content:

Laboratory 1: Study of the Behavior of 1st, 2nd, and 3rd Order Systems

Analog and Computer Simulation. Measure the parameters that characterize the different responses: rise time; response time; first maximum overshoot, peak time, and accuracy. Observe the response of an unstable system.

Laboratory 2: Frequency Responses and System Identification

Determination of the frequency characteristics of a control system, with the aim of identifying a system's transfer function. Application to a motor.

Lab 3: Position control of a DC motor, difference between position and speed

The influence of gain on the stability and static error of the system, The influence of speed feedback on system behavior.

Lab 4: Speed control of a DC motor

The operation of the components and the controlled system in open and closed loops, The influence of gain on system stability, The influence of gain and load on the static error of the system, The influence of current feedback on the dynamic behavior of the system.

Lab 5: Stability and accuracy of controlled systems

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

Sensors:

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

Assessment method:
Continuous monitoring: 100%.

Bibliographic references :

Semester: 5
Teaching unit: UED 3.1
Matter 1: Sensors and Metrology
VHS: 22h30 (Cours: 1h30)
Credits: 1
Coefficient: 1

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

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

Course Content:

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

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

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

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

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

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

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

Chapter 8. Data Acquisition Chain (1 Week)

Assessment Method:
Exam: 100%

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

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

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

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

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

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

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

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

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

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

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

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

Recommended Prior Knowledge:
Programming skills, Matlab skills.

Subject Content:

Chapter 1: Getting Started with MATLAB (2 weeks)
1.1 - Introduction
1.2 - MATLAB Environment
1.3 - Starting MATLAB
Command Window, Defined Variables Window (Workspace), Working Directory Window, Command History Window
1.4 - Overview and General Information
Getting Help, Getting Started, The Workspace, Single-Line Syntax, Managing Working Directory Files, Arithmetic Operations, Scalar Operations and Functions, Special Variables and Constants, Number Format and Calculation Precision, Command History

Chapter 2: Data Types and Variables (2 weeks)
2.1 - Data Types
2.2 - Variables
Complex Numbers, Boolean Variables, Strings, Vectors, Matrices, Polynomials. Chapter 3: Graphics (1 week)
3.1 - Managing Graphics Windows
3.2 - 2D Graphics Representation
Cartesian Coordinate Graphics, Improving Figure Readability, Polar Coordinate Graphics, Diagrams.
3.3 - 3D Graphics
3D Curves, Surfaces

Chapter 4: Programming in MATLAB (2 weeks)
4.1 - Arithmetic and Logic Operators and Special Characters
4.2 - M-Files
4.3 - Scripts and Functions
(Scripts, Functions)
4.4 - Control Statements
(FOR Loop, WHILE Loop, Conditional IF Statement)
Chapter 5: Getting Started with SIMULINK (3 weeks)
5.1 - SIMULINK Libraries
Libraries: Sources, Sinks, Continuous, Math Operations, Commonly Used Blocks, Signal Routing, Logic and Bit Operations, User-Defined Functions, Ports & Subsystems, etc.

5.2 - Quick Start
5.3 - Masks and Subsystems
5.2.1 - Subsystems
5.3.2 - Subsystem Masking
Subsystem Masking, Using Callbacks
5.4 - Study of Some Simulation Examples
Chapter 6: Power System Blockset (PSB) (2 weeks)
6.1 - Introduction to the Power System Blockset
6.2 - Study of a Simulation Example

Chapter 7: Simulation and Co-simulation with Other Software (3 weeks)
7.1 - Simulation with PSim and Simulink-PSim Co-simulation
7.2 - Simulation with Other Software: PSpice, Proteus, Scilab, etc.

Assessment Method:
Exam: 100%.

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

Semester: 6
Teaching unit : UEF 3.2.1
Matter 1: Control of electrical machines
VHS: 67h30 (Course: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Course Objectives:

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

Recommended Prior Knowledge:

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

Course Content:

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

Chapter 2. Static Converter Control (1 Week)

PWM Technique

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

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

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

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

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

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

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

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

Assessment method:

Continuous monitoring: 40%; Exam: 60%.

Bibliographic references:

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

Semester: 6
Teaching unit : UEF 3.2.1
Matiter 2: Industrial regulation
VHS: 45h00 (Course: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:

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

Recommended Prior Knowledge:

Knowledge of continuous linear servocontrol and general electricity.

Course Content:

Chapter 1. Introduction to Industrial Control (2 Weeks)

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

Chapter 2. On-Off Controller (2 Weeks)

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

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

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

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

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

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

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

Chapter 6. Industrial Applications (3 weeks)

Temperature, flow, pressure, and level regulation.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

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

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

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

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

Course Content:

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

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

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

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

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

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

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

5. William Bolton, "Programmable Industrial Automation", Dunod, 2009.
6. Khushdeep Goyal and Deepak Bhandari, "Industrial Automation and Robotics", Katson Books, 2008.
7. Gérard Boujat, Patrick Anaya, "Industrial Automation in 20 Fact Sheets", Dunod, 2013.
8. Simon Moreno, Edmond Peulot, "Grafcet: Design and Implementation in Programmable Automation" Industrial Automation", Edition Casteilla 2009.
9. G. Michel, "APIs: Architecture and Applications of Industrial Programmable Logic Controllers", Edition Dunod, 1988.
10. William Bolton, "Industrial Programmable Logic Controllers", Edition Dunod, 2010.
11. Frederic P. Miller, Agnes F. Vandome, John McBrewster, "Industrial Programmable Logic Controllers: Computer Programming, Automation, Industry, Programming (Computer), Switch, Automation Engineer", Edition Alphascript Publishing, 2010.

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

Learning Objectives:

Choose the appropriate material based on its operating conditions and environment.

Recommended Prior Knowledge:

Construction of matter, electric field theory, and disruptive electric discharge.

Course Content:

Part I - Electrotechnical Materials

Chapter 1. Conductive Materials (1 Week)

Basic Concepts, Classification of Conductors and Properties According to Their Use.

Chapter 2. Magnetic Materials (3 Weeks)

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

Chapter 3. Dielectric Materials (2 Weeks)

Polarization Phenomena, Resistivity, Dielectric Strength and Dielectric Losses, Physicomechanical Properties, Electrically Insulating Materials.

Chapter 4. Semiconductor Materials (1 Week)

General Information on Semiconductors and Their Applications.

Chapter 5. Superconducting Materials (1 Week)

General Information on Superconductors and Their Applications.

Part II - Introduction to High Voltage

Chapter 1. General Information on High Voltage (1 Week)

Voltage Ranges, Usefulness of High Voltage, Selection of HV Equipment, Technological and Industrial Applications of High Voltage

Chapter 2. General Information on HV Stresses (2 Weeks)

Purposes and Methodology of HV, Voltage-Related Stresses, Current-Related Stresses, Overvoltage and Overcurrent Protection.

Chapter 3. High Voltage Measurement (2 Weeks)

High Voltage Sources, High Voltage Measurement.

Chapter 4: High Voltage Transient Phenomena (2 Weeks)

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

Assessment Method:

Continuous Assessment: 40%; Exam: 60%.

Bibliographic References:

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

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

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

Teaching Objectives:

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

Recommended Prior Knowledge:

The entire Bachelor's program.

Subject Content:

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

Notes:

During the weeks when students are familiarizing themselves with the purpose of their project and its feasibility (bibliographic research, searching for software or hardware needed to conduct the project, reviewing and consolidating lessons directly related to the topic, etc.), the subject leader must use this in-person time to remind students of the essential content of the two subjects "Writing Methodology" and "Presentation Methodology" covered during the first two semesters of the core curriculum.

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

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

Mode d'évaluation:

Contrôle continu: 100%.

Semester: 6
Teaching unit: UEM 3.2
Matière 2: TP Machine control
VHS: 15h00 (TP: 1h00)
Credits: 1
Coefficient: 1

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

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

Course Content:

Laboratory Work 1: Starting a DC Motor

Laboratory Work 2: Combining a Bidirectional Rectifier with a DC Machine

Laboratory Work 3: Combining a Chopper with a DC Machine

Laboratory Work 4: Combining an Inverter with an AC Machine

Laboratory Work 5: Combining a Frequency Converter with an AC Machine

Laboratory Work 6: Studying Stepper Motor Control

Assessment Method:
Continuous Control: 100%.

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

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

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

Recommended Prior Knowledge:
Controlled systems and control courses.

Course Content:

Laboratory Work 1: Frequency Responses and System Identification.

Laboratory Work 2: Controller Characteristics.

Laboratory Work 3: Analog (PID) Fluid Level Control.

Laboratory Work 4: Speed Control of an MCC Motor.

Laboratory Work 5: Pressure Control.

Laboratory Work 6: Temperature Control.

Assessment Method:
Continuous Assessment: 100%

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

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

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

Recommended Prior Knowledge:
Course Content.

Subject Content:

Laboratory Work: Industrial Automation

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

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

Assessment method:
Continuous assessment: 100%.

Bibliographic references:
Lecture notes and lab brochures.

Semester: 6
Teaching unit: UED 3.2
Matter 1: Protection of electrical networks
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:

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

Recommended Prior Knowledge:

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

Course Content:

Chapter 1. Introduction to Protection (4 weeks)

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

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

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

Chapter 3. Protection System Elements (3 weeks)

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

Chapter 4. Protection of Network Elements (5 weeks)

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

Assessment method:

Exam: 100%

Bibliographic references:

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

3. Christophe Prévé, "Protection of Electrical Networks," Hermes Paris, 1998.
4. S. H. Horowitz, A. G. Phadke, "Power System Relaying," Second Edition, John Wiley & Sons, 1995.
5. L. Féchant, "LV Electrical Switchgear, Distribution Devices," Engineering Techniques, Electrical Engineering Treatise, D 4 865.
6. S. Vacquié, A. Lefort, "Physical Study of the Electric Arc, The Electric Arc and Its Applications," Volume 1, CNR ed., S 1984.

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

Course Objectives:

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

Recommended Prior Knowledge:

Statistics, apparatus, measurements, and instrumentation.

Course Content:

Chapter 1. General Information on Maintenance (4 Weeks)

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

Chapter 2. Maintenance Organization and Management (4 Weeks)

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

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

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

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

Assessment Method:

Exam: 100%

Bibliographic References:

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

Semestre: 6
Teaching unit : UET 3.2
Matter : Entrepreneurship and business management
VHS : 22h30 (Course : 1h30)
Credits : 1
Coefficient : 1

Teaching Objectives:

- Prepare for professional integration upon graduation;
- Develop entrepreneurial skills among students;
- Raise awareness and familiarize students with the opportunities, challenges, procedures, characteristics, attitudes, and skills required for entrepreneurship;
- Prepare students so that they may one day start their own business or, at least, better understand their work in an SME.

Recommended Prior Knowledge:

No specific knowledge, except fluency in the language of instruction.
Targeted Skills:

Ability to analyze, synthesize, work in a team, communicate effectively orally and in writing, be independent, plan and meet deadlines, and be responsive and proactive. Gain an awareness of entrepreneurship through an overview of management skills useful for business creation.

Course Content:

Chapter 1 – Operational Job Preparation: (2 Weeks)
Writing a cover letter and CV, Job interviews, etc., Document research on careers in the sector, Interviews with professionals in the field, and Mock job interviews.

Chapter 2 - Entrepreneurship and Entrepreneurial Spirit: (2 Weeks)
Entrepreneurship, Businesses Around You, Entrepreneurial Motivation, Knowing How to Set Goals, Knowing How to Take Risks

Chapter 3 - The Profile of an Entrepreneur and the Entrepreneurial Profession: (3 Weeks)
The Qualities of an Entrepreneur: Knowing How to Negotiate, Knowing How to Listen, The Place of SMEs and VSEs in Algeria, The Main Success Factors When Creating a VSE/SME

Chapter 4 - Finding a Good Business Idea: (2 Weeks)
Creativity and Innovation, Recognizing and Evaluating Business Opportunities

Chapter 5 - Starting and Running a Business: (3 Weeks)
Choosing an Appropriate Market, Choosing a Location for Your Business, Legal Forms of Business, Seeking Help and Financing to Start a Business, Recruiting Staff, Choosing Suppliers

Chapter 6 - Developing a Business Plan: (3 Weeks) Weeks)
The Business Model and the Business Plan, Implementing Your Business Project with the Business Model Canvas

Assessment Method: Exam: 100%

References:

- Fayolle Alain, 2017. Entrepreneurship Theories and Practices, Applications for Learning to Start a Business. Dunod, 3rd ed.
- Léger Jarniou, Catherine, 2013, The Entrepreneur's Big Book. Dunod, 2013.
- Plane Jean-Michel, 2016, Organizational Management Theories, Concepts, Performance. Dunod, 4th ed.
- Léger Jarniou, Catherine, 2017, Building Your Business Plan. The Entrepreneur's Big Book. Dunod,
- Sion Michel, 2016, Making Your Business a Success: Methods, Tools, and Planning Tips. Dunod, 4th ed.
- Patrick Koenblit, Carole Nicolas, and Hélène Lehongre, Building Your Career Project, ESF, Publisher 2011.
- Lucie Beauchesne and Anne Riberolles, Building Your Career Project, L'Etudiant 2002.
- Claude ALBAGLI and Georges HENAULT (1996), Business Creation in Africa, ed. EDICEF/AUPELF, 208 p.

IV- Agreements / Conventions

STANDARD LETTER OF INTENT
(In case of a license co-sponsored by another university establishment)

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

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

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

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

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

SIGNATURE of the legally authorized person:

POSITION:

Date:

SAMPLE LETTER OF INTENT

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

(Official letterhead on the company's letterhead)

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

Delivered to:

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

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

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

- Participate in seminars organized for this purpose,

- Participate in thesis defense juries,

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

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

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

SIGNATURE of the legally authorized person:

POSITION:

Date:

OFFICIAL STAMP or COMPANY SEAL

V - Opinions and Visas of the Administrative and Consultative Bodies

License Title : Electrotechnical

Department Head + Domain Team Leader
Date and visa: Date and visa:
Doyen de la faculté (ou Directeur d'institut)
Date and visa:
Head of university establishment
Date and visa:

VI – Notice and Visa of the Regional Conference

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