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Democratic and Popular Republic of Algeria
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Ministry of Higher Education and Scientific Research

University

Logo

TRAINING OFFER
LMD

ACADEMIC LICENSE

NATIONAL PROGRAM
2018 – 2019

Establishment	Faculty / Institute	Department

Domain	Sector	Speciality
Sciences And Technologies	***Electromechanics***	***Industrial maintenance***

University

CPNDST

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Educational Committee National Domain
Science and Technology

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The Lord and the Lord

2018 to 2019

Al-Qaeda	Al-Qaeda/Al-Qaeda	Al-Qaeda

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The Lord of the Rings	ÿÿÿÿÿÿÿÿÿÿ	ÿÿÿÿ ÿ ÿÿÿÿÿÿÿÿ

I – License Identity Card

1 - Location of the training :

Faculty (or Institute):

Department :

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

2- External partners:

Other partner establishments:

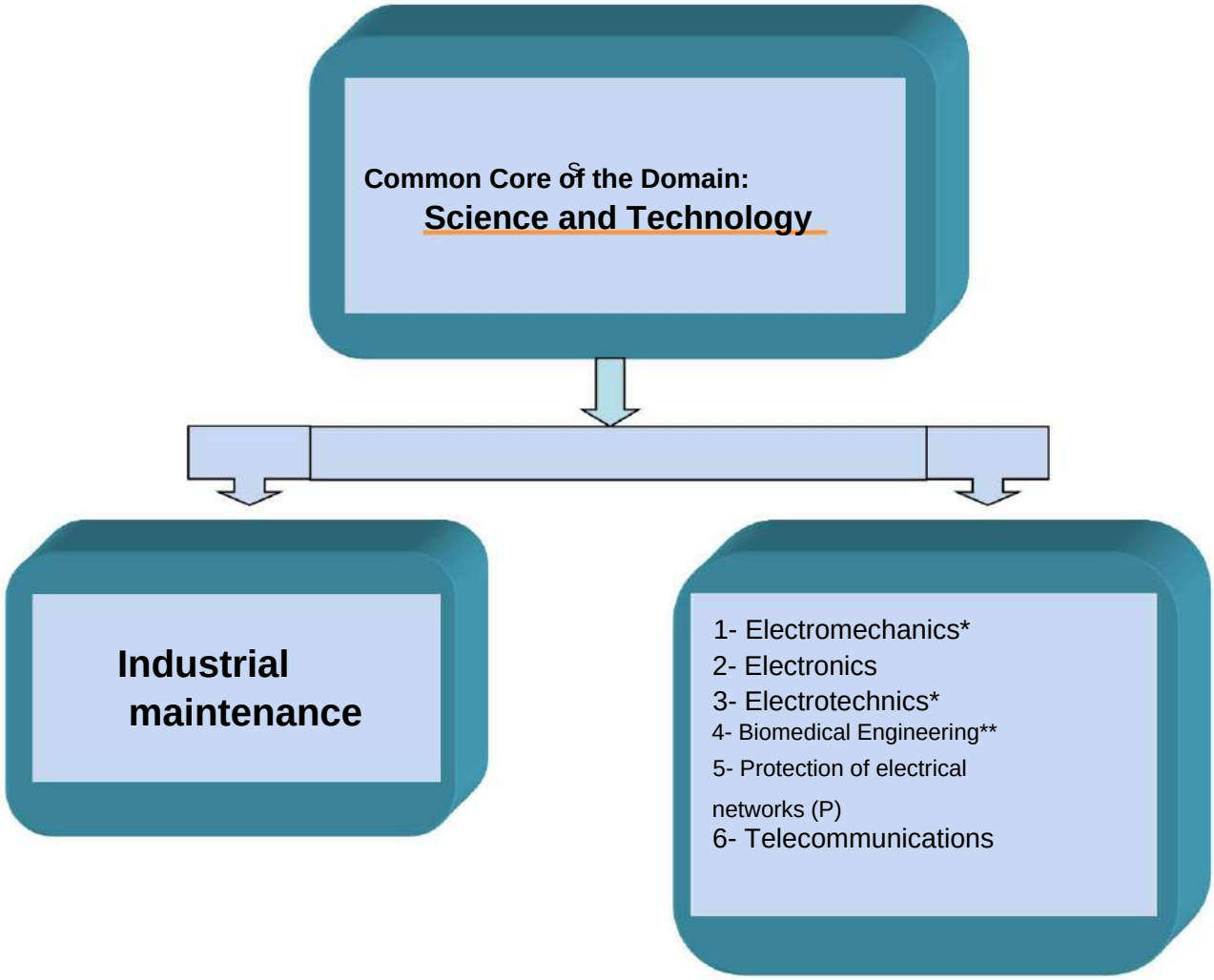
Businesses and other socio-economic partners:

International partners:

3 – Context and objectives of the training

A – General organization of the training : position of the project

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



B - Training objectives:

The objective of this degree is to train managers in industrial maintenance who will be able, in the exercise of their functions, to accomplish the following tasks:

1. Define and implement maintenance techniques,
2. Manage maintenance actions,
3. Manage the maintenance of complex industrial production systems,
4. Design solutions to improve operational safety,
5. Schedule and carry out equipment maintenance operations automated,
6. Enforce and respect safety and environmental standards,
7. Ensure the operational safety of industrial equipment at lower cost,
8. Lead a team and manage projects in design offices and/or in production workshops,

The specialist manager, holding a degree in Industrial Maintenance, is capable of ensuring the proper functioning of an industrial installation. As part of his duties, he will be required to perform functions as diverse as:

1. Technical function: maintenance of resources, troubleshooting, etc.
2. Management function: maintenance management, inventory management, etc.
3. Quality and safety function: reliability, operational safety, etc.
4. Communication function: inter-departmental relations, management, etc.

C – Targeted profiles and skills:

In addition to the academic aspect for which graduates of this Bachelor's degree are trained and which allows them to pursue Master's studies, the Bachelor's degree in Industrial Maintenance also aims to train professionals in the methods and tools of the field of maintenance and allow them to occupy management positions in companies (maintenance manager or deputy manager, methods service assistant, senior maintenance technician, production manager, etc.).

Graduates from this training course who wish to enter the professional world will have acquired the necessary skills that enable them to master the different aspects of the profession:

1. Industrial equipment technology,
2. Maintenance of production means,
3. The reliability of production means,
4. Operational safety,
5. Maintenance management,
6. The economy of maintenance,
7. Inventory management,
8. New works and subcontracting,
9. Safety, legal obligations and standardization.

D – Regional and national employability potential:

Algeria has a very large industrial base, offering enormous potential for professional integration for holders of a Bachelor's degree in Industrial Maintenance. Indeed, industrial machinery and equipment are omnipresent in all companies spread throughout the country.

Students with a degree in Industrial Maintenance can be recruited to perform the following functions:

1. Maintenance workshop manager,
2. Head of maintenance and upkeep department,
3. Head of maintenance and new works department,
4. Maintenance group leader manager,
5. Operational collaborators in university laboratories.

The areas of activity are varied and concern:

6. Mechanical industries in general,
7. Constructions and works of Mechanical Engineering, 8. The field of materials (metal, composite, plastic, glass, etc.),
9. The transport sector (automobile, aeronautics, railways), 10. The sector of development of industrial products by transformation of materials.

E – Gateways to other specialties:

Semesters 1 and 2 common	
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
Automatic	Automatic
Electromechanics	Electromechanics
	Industrial maintenance
Electronic	Electronic
Electrical engineering	Electrical engineering
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
Electromechanics	Electromechanics Industrial maintenance
Electronic	Electronic
Electrical engineering	Electrical engineering
Biomedical Engineering	Biomedical Engineering
Industrial engineering	Industrial engineering
Telecommunication	Telecommunication

Group of streams 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 degree 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.

Half	Group of sectors	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 group of courses at the end of semester 3 (Subject to conditions of equivalence and opinion of the training team).

- All specialties in the same group of courses at the end of semester 4
(Subject to conditions of equivalence and opinion of 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.

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 the training:

ÿ Evolution of the rate of students who have chosen this degree (supply/demand ratio). ÿ Rate and quality of students who choose this degree.

During training:

ÿ Regularity of educational committee meetings. ÿ Conformity of the themes of the End of Cycle Projects with the nature of the training.
ÿ Quality of the relationship between students and the administration.
ÿ Support provided to students in difficulty.
ÿ Student satisfaction rate with teaching and methods teaching.

Downstream of the training:

ÿ Student success rate per semester in this degree. ÿ Student dropout rate (failures and dropouts).
ÿ Identification of the causes of student failure.
ÿ Reorientation alternatives are offered to students who fail.
ÿ Rate of students who graduate on time. ÿ Rate of students who continue their studies after the bachelor's 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, upon request, be made available to the various institutions: National Educational Committee for the Field of Sciences and Technologies,
Regional Conferences, Vice-Rectorate in charge of pedagogy, Faculty, etc.

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

ÿ Equipping teaching rooms and laboratories with materials and supports necessary for improving teaching (projection systems (data shows), Wi-Fi connection, etc.).

ÿ Existence of a communication and teaching platform in which courses, tutorials and practical work are accessible to students and their questions are answered.
ÿ Equipping educational laboratories with materials and equipment in adequacy with the content of the lessons.

- ÿ Number of actual teaching weeks provided during a semester and what about student absenteeism?
- ÿ Rate of completion of teaching programs.
- ÿ Digitization and conservation of End of Studies and/or End of Cycle dissertations.
- ÿ Number of practical work carried out as well as the multiplication of the type of practical work per subject (diversity of practical work).
- ÿ Quality of the establishment's documentary collection in relation to the specialty and its accessibility.
- ÿ Support from the socio-economic sector for training (company visits, company internships, courses and seminars given by professionals, etc.).

3. Integration of graduates:

A coordination committee is created, composed of training managers and members of the Administration, which is mainly responsible for monitoring the integration of graduates of the sector into professional life, for creating a monitoring file of graduates of the sector, for identifying and/or updating existing economic and industrial potential at regional and national level, for anticipating and encouraging new professions related to the sector in association with the chamber of commerce, the various employment support agencies, public and private operators, etc., for participating in any action concerning the professional integration of graduates (organization of events with socio-economic operators).

To carry out these missions, this committee has full discretion to conduct or commission any study or survey on the employment and post-employment of graduates. Below is a list of indicators and methods that could be considered to evaluate and monitor this operation:

- ÿ Recruitment rate of graduates in the socio-economic sector in a position in direct relationship with training.
- ÿ Nature of jobs held by graduates.
- ÿ Diversity of outlets.
- ÿ Establishment of an association of former graduates of the sector.
- ÿ Creation of small businesses by graduates of the specialty.
- ÿ Degree of employer satisfaction.

G- Student assessment through continuous assessment and personal work:

G1- Evaluation 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 done 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 teacher responsible for the subject must organize himself by proposing a series of exercises for each chapter of the course. This series must be exhaustive, with exercises for understanding the course and standard exercises to be solved during tutorial sessions.
These exercises must be prepared by the student before attending the tutorial. This preparation may be assessed. The assessment method is left to the discretion of the instructor in charge of the tutorial.

Exercises not resolved in TD can be the subject of personal 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 programs where numbers are reduced, attendance must be compulsory in lectures and tutorials.

2. Case of methodological units (Practical work):

Just like the tutorials, the practical exercises must be prepared by the student. A test to check this preparation must be organized by the teacher before each manipulation (in the form of short comprehension questions, multiple choice questions, diagram of the manipulation, etc.). A report (by working group) must be submitted at the end of the practical work session.

title, the teacher must prepare a standard report (outline) to facilitate the work for the students so that they can actually submit it at the end of the practical session.
At the end of the semester, the teacher organizes a practical test which summarizes all of the manipulations carried out by the student.

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

It is very difficult to carry out 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 numbers of students.

However, the teacher in charge of this subject may, if he/she wishes, inform the students that he/she may possibly assess them (ongoing) by asking them to prepare presentations, to make reports, to research the course supplement, to use free software, to ask the students to watch at home a popular science film related to the subject (after having given them either the film on electronic media or having given them the internet link to this film) and then asking them to submit a written report or to make an oral presentation of the summary of this film, etc. The bonus for these activities is left to the discretion of the teacher and the training team who alone are able to define the best way to take this personal work into account in the overall mark of the final exam.

Along the same lines, and in the case where the number of students in this subject is reasonable (20 to 30 students), which may be the case for many masters, the head of the subject may consider continuous assessments of the student similar to what is done in subjects with tutorials. The only obligation to respect is that students should be informed of this procedure and validated during the first Academic Council.

In any case, the teacher and the teaching team are free to include any type of assessment they deem appropriate to encourage students to take better charge of their course and, at the same time, combat the phenomenon of student absenteeism.
to the courses.

4. Harmonization of continuous monitoring:

Using a common assessment grid would promote the harmonization of these practices from one teacher 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 do this, we propose below an indicative assessment grid which presents the different continuous assessments allowing us to evaluate the degree of acquisition of students' skills, 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 them. On the contrary, the aim is to "honestly" assess the degree of assimilation of the various skills and knowledge taught to the student in complete
objectivity. In the same spirit, we would gain by promoting the contractualization of the assessment of learning by specifying, for example, the success criteria and good practices that would lead to correct and precise answers to the 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 assess students' ability to use 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 Report	20%	04 points
(must be submitted at the end of the practical work 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 student 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 knowledge and strengthen the training of students, they will be asked to complete 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, solve a difficult exercise, review in detail the proof of a theorem, research the complement to a course, use free software

or a CAD-CAM tool to make applications and simulations related to the course, ... These activities can be evaluated, graded and entered 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 teamwork spirit.

The theme of the mini course project must be well targeted and decided by the teacher for a group of students (2 to 5 maximum), sanctioned by a single report (10 pages maximum) and a short collective oral presentation (preferably with audio-visual support). A mark, common to the group, is awarded according to an evaluation grid (presentation of the document and use of bibliographic resources, oral presentation, respect for time, answers to questions, etc.) and will then be counted, as a bonus, in the continuous assessment mark.

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

Visits, educational outings, discovery and/or immersion courses are opportunities for students that can help them better understand the reality of the working world and help them achieve better professional integration later on.
Administrative managers and teachers must encourage, as much as possible, this very important aspect of training and ensure the organization of educational visits and outings throughout the training course.
They must also help/encourage students to prospect 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 holidays.

In this context, teachers must ensure that students take notes during these outings and require reports (reports of a few pages). This activity can be evaluated, graded, and recorded as a bonus for the student who completes it. Students can be offered templates *to* help them present their internship report effectively.

4. Participation in scientific events:

In order to instill a scientific spirit 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 assessed, graded and entered 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 between them (promotional pages,

discussion forum on a specific issue in a course, 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 lever for success, is largely based on the personal work that the student is required to do, by appropriating the resources and tools made available to them. All of this must, of course, be supervised and formalized within the framework of the educational monitoring and support that must be provided jointly by the university teacher and the administrative manager throughout the training course.

This autonomy will allow him to build his professional identity based on his aspirations, his abilities and his achievements or even to build his academic career in the pursuit of higher education.

4 - Human resources available:

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	Specialty diploma (Master, 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	Specialty diploma (Master, doctorate)	Grade	Materials to teach	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
Teachers			
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)**

Lab title:

Student capacity:

No.	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	Materials Titled	Credits	Coefficient	Hourly volume weekly Course	TD	TP		Volume Hourly Biannual (15 weeks)	Work Complementary in consultation (15 weeks)	Assessment method Control Continuous	Exam
Fundamental EU 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%
Methodological EU Code: UEM 1.1 Credits: 9 Coefficients: 5	Physics 1 Practical Work	2	1				1h30	10:30 p.m.	27:30	100%	
	Chemistry 1 practical work	2	1				1h30	10:30 p.m.	27:30	100%	
	Computer Science 1	4	2	1h30			1h30	45h00	55h00	40%	60%
	Writing methodology	1	1	1h00				3:00 p.m.	10:00 a.m.		100%
EU Discovery Code: UED 1.1 Credits: 1 Coefficients: 1	Careers in Science and Technologies 1	1	1	1h30				10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 1.1 Credits: 2 Coefficients: 2	Foreign language 1 (French and/or English)	2	2	3h00				45h00	5:00 a.m.		100%
Total semester 1		**30**	**17**	**4:00 p.m.**	**4:30 a.m.**		**4:30 a.m.**	**375 hours**	**375 hours**		

Semester 2

Teaching unit	Materials Titled	Credits	Coefficient	Hourly volume weekly Course	TD	TP		Volume Hourly Biannual (15 weeks)	Work Complementary in consultation (15 weeks)	Assessment method Control Continuous	Exam
Fundamental EU 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%
Methodological EU Code: UEM 1.2 Credits: 9 Coefficients: 5	Physics 2 Practical Work	2	1				1h30	10:30 p.m.	27:30	100%	
	Chemistry 2 practical work	2	1				1h30	10:30 p.m.	27:30	100%	
	Computer Science 2	4	2	1h30			1h30	45h00	55h00	40%	60%
	Presentation methodology	1	1	1h00				3:00 p.m.	10:00 a.m.		100%
EU Discovery Code: UED 1.2 Credits: 1 Coefficients: 1	Careers in Science and Technologies 2	1	1	1h30				10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 1.2 Credits: 2 Coefficients: 2	Foreign language 2 (French and/or English)	2	2	3h00				45h00	5:00 a.m.		100%
Total semester 2		**30**	**17**	**4:00 p.m.**	**4:30 a.m.**		**4:30 a.m.**	**375 hours**	**375 hours**		

Semester 3

Teaching unit	Materials Titled	Credits	Coefficient	Hourly volume weekly Course	TD	TP		Volume Hourly Biannual (15 weeks)	Work Complementary in consultation (15 weeks)	Assessment method Control Continuous	Exam
Fundamental EU 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%
Fundamental EU Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Fundamental Electronics 1	4	2	1h30	1h30			45h00	55h00	40%	60%
	Fundamental Electrical Engineering 1	4	2	1h30	1h30			45h00	55h00	40%	60%
Methodological EU Code: UEM 2.1 Credits: 9 Coefficients: 5	Probabilities and statistics	4	2	1h30	1h30			45h00	55h00	40%	60%
	Computer Science 3	2	1			1h30		10:30 p.m.	27:30	100%	
	Practical work in Electronics and Electrical Engineering	2	1			1h30		10:30 p.m.	27:30	100%	
	TP Waves and vibrations	1	1			1 hour		3:00 p.m.	10:00 a.m.	100%	
EU Discovery Code: UED 2.1 Credits: 2 Coefficients: 2	State of the art of engineering electric	1	1	1h30				10:30 p.m.	2:30 a.m.		100%
	Energy and environment	1	1	1h30				10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 2.1 Credits: 1 Coefficients: 1	Technical English	1	1	1h30				10:30 p.m.	2:30 a.m.		100%
Total semester 3		**30**	**17**	**1:30 p.m.**	**7:30 a.m.**	**4:00 a.m.**		**375 hours**	**375 hours**		

Semester 4

Teaching unit	Titled	Credits	Coefficient	Hourly volume weekly			Volume Hourly Biannual (15 weeks)	Work Complementary in consultation (15 weeks)	Assessment method	
				Course	TD	TP			Control Continuous	Exam
Fundamental EU Code: UEF 2.2.1 Credits: 10 Coefficients: 5	Hydraulics and pneumatics	6	3	3h00	1h30		67h30	82h30	40%	60%
	Combinatorial logic and sequential	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 2.2.2 Credits: 8 Coefficients: 4	Numerical methods	4	2	1h30	1h30		45h00	55h00	40%	60%
	Resistance of materials	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological EU Code: UEM 2.2 Credits: 9 Coefficients: 5	Electrical and electronic measurements practical work	2	1			1h30	10:30 p.m.	27:30	100%	
	Logic TP	1	1			1 hour	3:00 p.m.	10:00 a.m.	100%	
	Hydraulic and pneumatic construction	2	1			1h30	10:30 p.m.	27:30	100%	
	Numerical Methods Practical Work	2	1			1h30	10:30 p.m.	27:30	100%	
	Technical Drawing	2	1			1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 2.2 Credits: 2 Coefficients: 2	Energy conversion systems	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
	Concepts of electrical and electronic measurements	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 2.2 Credits: 1 Coefficients: 1	Expression and communication techniques	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Total semester 4		**30**	**17**	**12:00**	**6:00**	**7:00**	**375 hours**	**375 hours**		

Semester 5

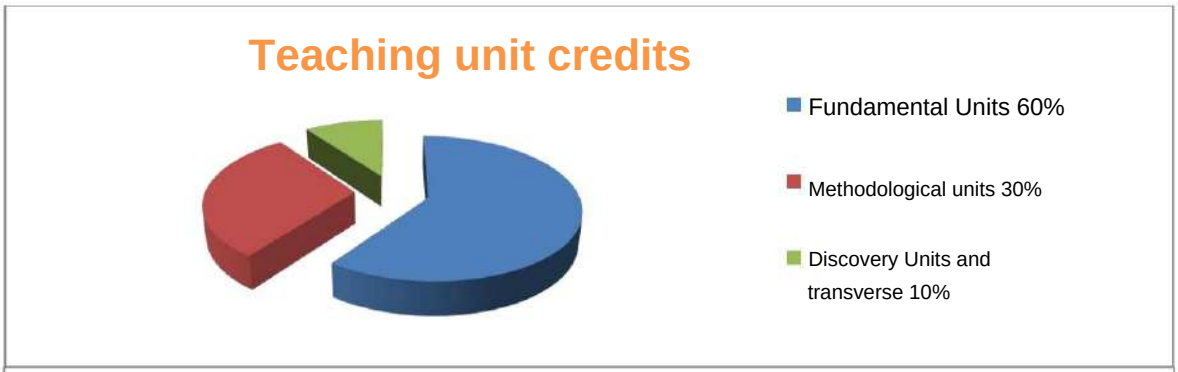
Teaching unit	Materials Titled	Credits	Coefficient	Hourly volume weekly Course	TD	TP		Volume Hourly Biannual (15 weeks)	Work Complementary in consultation (15 weeks)	Assessment method Control Continuous	Exam
Fundamental EU Code: UEF 3.1.1 Credits: 10 Coefficients: 5	Machine elements	6	3	3h00	1h30			67h30	82h30	40%	60%
	Organization and method of maintenance	4	2	1h30	1h30			45h00	55h00	40%	60%
Fundamental EU Code: UEF 3.1.2 Credits: 8 Coefficients: 4	Electronic applied	4	2	1h30	1h30			45h00	55h00	40%	60%
	Applied electrical engineering	4	2	1h30	1h30			45h00	55h00	40%	60%
Methodological EU Code: UEM 3.1 Credits: 9 Coefficients: 5	TP Management of Computer-Aided Maintenance	3	2	1h30			1 hour	37h30	37h30	40%	60%
	Electronics and Practical Work of Electrical Engineering applied	2	1				1h30	10:30 p.m.	27:30	100%	
	Industrial design and CAD	2	1				1h30	10:30 p.m.	27:30	100%	
	Metrology and assembly practical work	2	1				1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 3.1 Credits: 2 Coefficients: 2	Heat Transfer Elements	1	1	1h30				10:30 p.m.	2:30 a.m.		100%
	Sensors and Metrology	1	1	1h30				10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 3.1 Credits: 1 Coefficients: 1	Environment and sustainable development	1	1	1h30				10:30 p.m.	2:30 a.m.		100%
Total semester 5		**30**	**17**	**1:30 p.m.**	**6:00 a.m.**		**5:30 a.m.**	**375 hours**	**375 hours**		

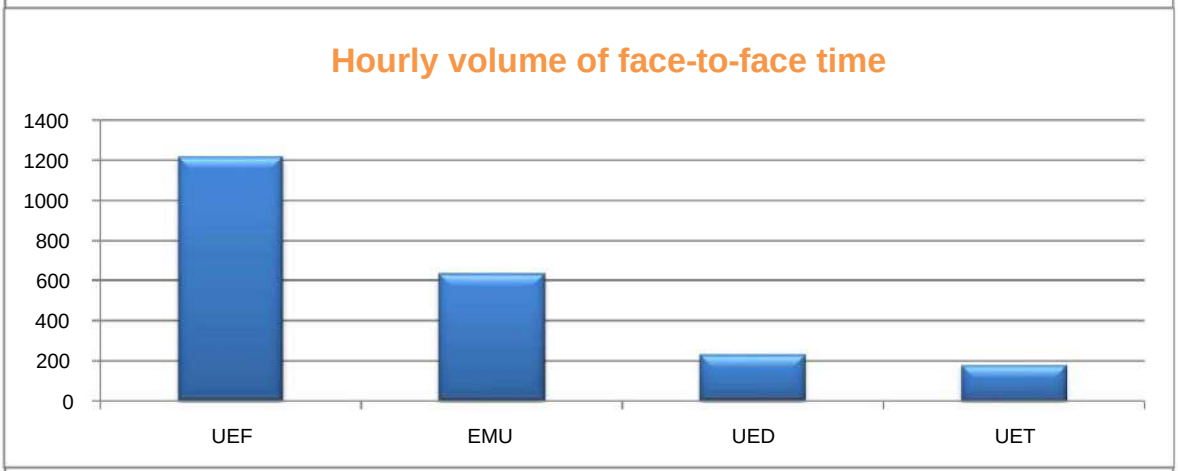
Semester 6

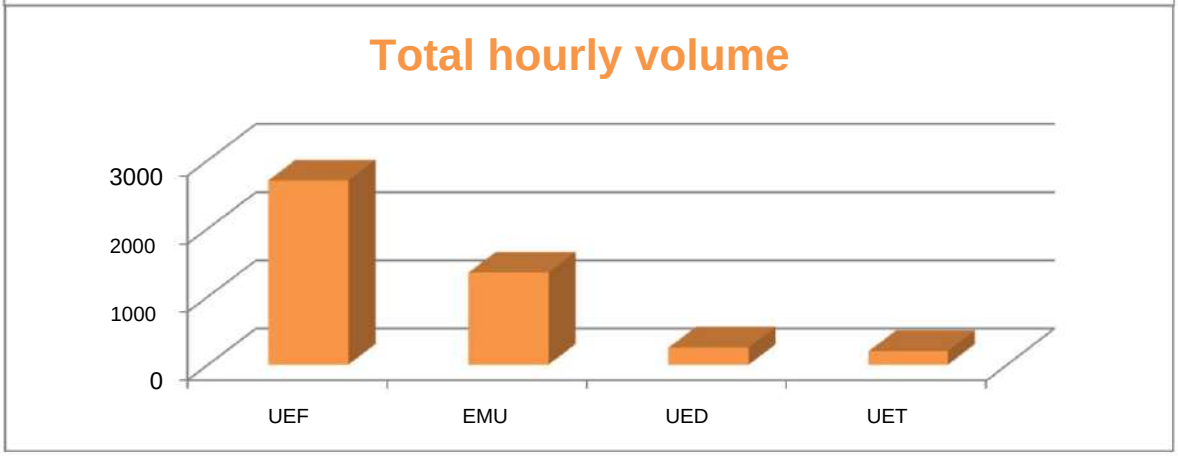
Unit teaching	Materials Titled	Credits	Coefficient	Hourly volume weekly Course	TD	TP	Volume Hourly Biannual (15 weeks)	Work Complementary in consultation (15 weeks)	Assessment method Control Continuous	Exam
Fundamental EU Code: UEF 3.2.1 Credits: 8 Coefficients: 4	Thermal and hydraulic machine technology	4	2	1h30	1h30		45h00	55h00	40%	60%
	Dynamics of structures	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 3.2.2 Credits: 10 Coefficients: 5	Signal processing	4	2	1h30	1h30		45h00	55h00	40%	60%
	Servo systems and Regulation	4	2	1h30	1h30		45h00	55h00	40%	60%
	Reliability	2	1	1h30			10:30 p.m.	27:30		100%
Methodological EU Code: UEM 3.2 Credits: 9 Coefficients: 5	End of Cycle Project	4	2			3:00 a.m.	45h00	55h00	100%	
	Combustion engine internal	3	2	1h30	1h00		37h30	37h30	40%	60%
	Repairs and interventions/MCI public works	2	1			1h30	10:30 p.m.	10:30 p.m.	100%	
EU Discovery Code: UED 3.2 Credits: 2 Coefficients: 2	Maintenance tools conditional preventive	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
	Industrial robotics	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Transversal EU Code: UET 3.2 Credits: 1 Coefficients: 1	Professional project and business management	1	1	1h30			10:30 p.m.	2:30 a.m.		100%
Total semester 6		**30**	**17**	**1**	**30 p.m.**	**7:00 a.m.**	**4:30 a.m.**	**375 hours**	**375 hours**	

Overall training summary:

EU / VH	UEF	EMU	UED	UET	Total
Course	720h00	4:00 p.m.	225h00	6:00 p.m.	1267h30
TD	495h00	10:30 p.m.	---	---	5:17 p.m.
TP	---	442h30	---	---	465h00
Personal work	1485h00	720h00	25h00	8:00 p.m.	2250h00
Other (specify)	---	---	---	---	---
Total	2700h00	1350h00	250h00	8:00 p.m.	4500h00
Credits	108	54	10	8	180
% in credits for each EU	60%	30%	10%		100%







III - Detailed program by subject

Semester: 1

Teaching unit: UEF 1.1

Subject 1: Mathematics 1

VHS: 67h30 (Lecture: 3h00, Tutorial: 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 1-1 Direct **(1 Week)**
Reasoning. 1-2 Reasoning by Contraposition. 1-3 Reasoning by Absurdity. 1-4 Reasoning by Contraexample. 1-5 Reasoning by Recurrence.

Chapter 2. Sets, Relations and Applications 2.1 Set Theory. 2-2 **(2 Weeks)**
Order Relation, Equivalence Relations. 2-3 Injective, Surjective, Bijective Application: Definition of an Application, Direct Image, Reciprocal Image, Characteristic 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 4-1 Power **(3 Weeks)**
Function. 4-2 Logarithmic Function. 4-3 Exponential Function. 4-4 Hyperbolic Function. 4-5 Trigonometric Function. 4-6 Inverse Function

Chapter 5. Limited Development 5-1 **(2 Weeks)**
Taylor's Formula. 5-2 Limited Development. 5-3 Applications.

Chapter 6. Linear Algebra 6-1 **(4 Weeks)**
Laws and internal composition. 6-2 Vector space, basis, dimension (definitions and elementary properties). 6-3 Linear application, kernel, image, 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 exercises in higher algebra, Moscow Edition

4- M. Balabne, M. Duflo, M. Frish, D. Guegan, Geometry – 2 e first cycle year classes preparatory, Vuibert University.

5- B. Calvo, J. Doyen, A. Calvo, F. Boshet, Algebra exercises, 1st scientific cycle preparation for the 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
Subject 2: Physics 1
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

Introduce the student to the basics of Newtonian physics through three main parts: Kinematics, Dynamics and Work and Energy.

Recommended prior knowledge

Notions of mathematics and physics.

Content of the material:

Mathematical reminders (2 Weeks)

1- Dimensional equations
2- Vector calculus: scalar product (norm), vector product, multivariate functions, derivation. Vector analysis: gradient, rotational operators, etc.

Chapter 1. Cinematics (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: Movement of the material point in different coordinate systems. 4- Relative movement.

Chapter 2. Dynamics: (4 Weeks)

1- General: Mass - Force - Moment of force - Absolute and Galilean reference frame. 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, speed-dependent, central force, etc.).

Chapter 3. Work and Energy (4 Weeks)

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

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. A. Gibaud, Mr. 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. PA Tipler, G. Mosca; Physics For Scientists and Engineers, 6th Ed., WH Freeman Company, 2008.

Semester: 1

Teaching unit: UEF 1.1
Subject 3: Structure of matter

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

Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

Basic notions of mathematics and general chemistry.

Content of the material:

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

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

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

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

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

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

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

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

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

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

Chapter 6: Chemical Bonds **(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. SS Zumdhal & coll., General Chemistry, De Boeck University.
3. Y. Jean, Electronic structure of molecules: 1 from the atom to simple molecules, 3rd edition, Dunod, 2003.

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

Semester: 1

Teaching unit: UEM 1.1 Subject 1: Physics

1 VHS: 22:30 (TP: 1h30)

Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge: Notions of mathematics and physics.

Content of the material:

5 manipulations minimum (3 hours / 15 days):

- Methodology for presenting practical work 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

Subject 2: Chemistry 1 Practical Work

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

Credits: 2

Coefficient: 1

Teaching objectives

Consolidate the theoretical knowledge provided during the structure of matter course through a number of practical exercises.

Recommended prior knowledge

Basic Chemistry Concepts.

Content of the material:

1. Laboratory safety

2. Preparation of solutions

3. Notions on uncertainty calculations applied to chemistry.

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

5. Acid-base dosage by conductivity meter.

5. Oxidation-reduction assay

6. Determination of water hardness

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

Assessment method:

Continuous assessment: 100%

Semester: 1

Teaching unit: UEM 1.1

Subject 3: Computer Science 1

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

Credits: 4

Coefficient: 2

Objective and recommendations:

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

Recommended prior knowledge

Basic concepts of web technology.

Content of the material:

Part 1. **Introduction to Computer** **(5 Weeks)**

Science 1- Definition of Computer Science
2- Evolution of computing and computers
3- Information coding systems
4- Operating principle of a computer
5- Hardware part of a computer
6- System part
Basic systems (operating systems (Windows, Linux, Mac OS, etc.)
Programming languages, application software

Part 2. **Concepts of algorithm and program** 1- **(10 Weeks)**
Concept of an algorithm
2- Organizational chart representation
3- Structure of a program
4- The approach and analysis of a problem
5- Data structure: Constants and variables, Data types
6- Operators: assignment operator, relational operators, logical operators, arithmetic operations, priorities in operations
7- Input/output operations
8- Control structures: Conditional control structures, Repetitive control structures

Computer Science 1:

The practical exercises are intended to illustrate the concepts taught during the course. These exercises should begin with the lessons according to the following schedule:
• Introductory and familiarization work with the computer machine from a hardware and operating system point of view (exploration of the different functionalities of the OS)
• Introductory practical work on using a programming environment (Editing, Assembly, Compilation, etc.)

• Practical work on applying programming techniques seen in class.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references 1-

John Paul Mueller and Luca Massaron, Algorithms for Dummies large format, 2017.

2- Charles E. Leiserson, Clifford Stein and Thomas H. Cormen, Algorithmics: course with 957 exercises and 158 problems, 2017.
3- Thomas H. Cormen, Algorithms: Basic Notions, 2013.

Semester: 1

Teaching unit: UEM 1.1

Subject 4: Writing Methodology

VHS: 3:00 p.m. (Class: 1 hour)

Credits: 1

Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Basic French. Basic principles of writing a document.

Content of the material:

Chapter 1. Concepts and generalities on writing techniques - Definitions, standards **(2 Weeks)**

- Applications: writing a summary, a letter, a request

Chapter 2. Information retrieval, synthesis and exploitation - Information retrieval in libraries (Paper format: Books, Journals) **(3 Weeks)**

-Researching information on the Internet (Digital: Databases; Search engines, etc.).

- Applications

Chapter 3 Techniques and Procedures of Writing **(3 Weeks)**

- Basic Principles of Writing - Punctuation, Syntax, Sentences
- The length of sentences
- Division into paragraphs
- The use of a neutral style and writing in the third person
- Readability
- Objectivity
- Intellectual rigor and plagiarism

Chapter 4 Writing a Report **(4 Weeks)**

Cover pages, Summary, Introduction, Method, Results, Discussion, Conclusion, Bibliography, Appendices, Summary and Keywords

Chapter 5. Applications **(3 Weeks)**

Report of a practical work

Assessment method:

Control Exam: 100%.

Bibliographic references:

1. J.-L. Lebrun, Practical guide to scientific writing, EDP Sciences, 2007.
2. M. Fayet, Successful Reporting, 3rd edition, Eyrolles, 2009.
3. M. Kalika, Master's thesis - Managing a thesis, Writing a report, Preparing a defense, Dunod, 2016.
4. M. Greuter, Succeeding in your dissertation 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 models, 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

Subject 1: Careers in Science and Technology 1

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

Credits: 1

Coefficient: 1

Objective of the subject:

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

Recommended prior knowledge

None.

Content of the subject:

1. What are engineering sciences? (2 weeks)

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

2. Electronics, Telecommunications, Biomedical Engineering, Electrotechnics, Electromechanics, Optics & Precision Mechanics sectors: - Definitions, **(2 weeks)**

areas of application (Home automation, embedded applications for automobiles, Video surveillance, Mobile telephony, Optical fiber, Advanced scientific instrumentation, Imaging

and Medical Instrumentation , Giant Mirrors, Contact Lenses, Transport and Distribution of Electrical Energy, Power Generation Plants, Energy Efficiency, Maintenance of Industrial Equipment, Elevators, Wind Turbines, etc.

- Role of the specialist in these areas.

3. Automation and Industrial Engineering sectors: - **(1 week)**

Definitions, areas of application (Automated industrial chains, Numerical Control Machine Tools, Robotics, Inventory Management, Goods Traffic Management, Quality, - Role of the specialist in these areas.

4. Process Engineering, Hydrocarbons and Petrochemical Industries:

(2 weeks)

- Definitions, Pharmaceutical industry, Food industry, Leather and textile industry, Biotechnologies, Chemical and petrochemical industry, Plastics industry, Energy sector (oil, gas), etc.

- Role of the specialist in these areas.

5. Sustainable development (SD): (4 weeks)

Definitions, Global issues (climate change, Demographic transitions, Depletion of resources (oil, gas, coal, etc.), Biodiversity loss, etc.), SD diagram (Sustainable = Viable + Livable + Equitable), SD actors (governments, citizens, socio-economic sector, international organizations, etc.), Global nature of SD challenges

6. Sustainable engineering: (4 weeks)

Definition, Principles of sustainable engineering (definitions of: sustainable energy/energy efficiency, sustainable mobility/ecomobility, resource recovery (water, metals and minerals, etc.), production

sustainable), Relevance of sustainable engineering in ST sectors, Relationship between sustainability and engineering, Responsibility of engineers in carrying out sustainable projects, …

Student's personal work for this subject:

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

Group work: Development of job descriptions for professions in each sector based on recruitment advertisements found on job application sites (e.g. **http://www.onisep.fr/Decouvrir-les-metiers,** www.indeed.fr, **www.pole-emploi.fr)** (1 sector / group).

Depending on the capacity of the establishments, recommend calling on doctoral students and former graduates of the establishment in a tutoring/mentoring system where each group can call on its tutor/mentor to develop the job description/ discover the different ST professions.

Assessment method:

100% exam

Bibliographic references:

1- What jobs 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: Employment & career, 2010.
3- V. Bertereau and E. Ratière, What Job Are You Made For? Publisher: L'Étudiant, 6th edition, Collection: Métiers, 2015.

4- The great book of professions, Publisher: L'Étudiant, Collection: Métiers, 2017.
5- Careers in the aeronautics and space industry, Collection: Parcours, Edition: ONISEP, 2017.
6- Careers in electronics and robotics, Collection: Parcours, Edition: ONISEP, 2015.
7- Environmental and sustainable development professions, Collection: Parcours, Edition: ONISEP, 2015.

8- Construction and public works trades, Collection: Parcours, Edition: ONISEP, 2016.
9- Transport and logistics professions, Collection: Parcours, Edition: ONISEP, 2016.
10- Energy professions, Collection: Parcours, Edition: ONISEP, 2016.
11- Mechanical professions, Collection: Parcours, Edition: ONISEP, 2014.
12- Careers in chemistry, Collection: Parcours, Edition: ONISEP, 2017.
13- Web professions, Collection: Parcours, Edition: ONISEP, 2015.
14- Careers in biology, Collection: Parcours, Edition: ONISEP, 2016.

Semester: 1

Teaching unit: UET 1.1

Subject 1: French language1

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

Credits: 1

Coefficient: 1

Teaching objectives:

This subject aims to develop the following four skills: Oral comprehension, Written comprehension and Oral expression, Written expression through reading and studying texts.

Recommended prior knowledge:

Basic French.

Content of the material:

Below we offer a set of themes that cover fundamental sciences, technologies, economics, social issues, communication, sports, health, etc. The teacher can choose texts from this list to develop them during the course. Otherwise, they are free to address other themes of their choice. The texts can be borrowed from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular magazines, books, websites, audio and video recordings, etc.

For each text, the teacher helps the student develop their linguistic skills: listening, comprehension, and oral and written expression. In addition, they must use this text to identify the grammatical structures they will develop during the same class session. Here, for illustration purposes, we recall 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 The robots Artificial intelligence The Nobel Prize The Olympic Games Sports at school The Sahara The currency Assembly line work Ecology Nanotechnologies Optical fiber The engineering profession The power plant Energy efficiency The smart building Wind energy Solar energy	Punctuation. Proper nouns, Articles. Grammatical functions: The noun, The verb, The pronouns, The adjective, The adverb. The complement pronoun "le, la, les, lui, leur, y, en, me, te, … The agreements. The negative sentence. Don't…, Don't… yet, Don't… anymore, Don't… ever, Don't… point, … The interrogative sentence. Question with "Who, What, What", Question with "When, Where, How much, Why, How, Which, Which". The exclamatory sentence. Reflexive verbs. Impersonal verbs. The indicative tenses: Present, Future, Past Perfect, Simple Past, Imperfect. …

Assessment method:

Review: 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 Polytechnic School, 2009.
3. M. Boulares, J.-L. Frerot, Progressive French Grammar with 400 exercises, Advanced Level, CLE International.
4. Collective, Besherelles: Grammar for all, Hatier.
5. Collective, Besherelles: Conjugation for all, Hatier.
6. Mr. Grégoire, Progressive French Grammar with 400 exercises, Beginner Level, CLE International, 1997.
7. A. Hasni et al., Training in 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. JM Robert, Difficulties of French, Hachette, 10.
C. Tisset, Teaching the French language at school: Grammar, Spelling and Conjugation, Hachette Education, 2005.
11. J. Bossé-Andrieu, Summary of the Rules of Grammar and Spelling, University Press Quebec, 2001.
12. J.-P. Colin, French made simple, Eyrolles, 2010.
13. Collective, French Assessment Test, Hachette, 2001.
14. Y. Delatour et al., Practical French grammar in 80 cards with corrected exercises, Hachette, 2000.
15. Ch. Descotes et al., The Exerciser: French Expression for the Intermediate Level, Presses Grenoble University, 1993.
16. H. Jaraush, C. Tufts, On the Vif, Heinle Cengage Learning, 2011.
17. J. Dubois et al., The Essentials – Spelling, Larousse, 2009.

Semester: 1

Teaching Unit: UET 1.1 Subject 1: English Language 1 VHS: 10:30 p.m. (Course: 1.5 hours)
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 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 readings: Examples	**of Word Study: Patterns** Iron and Steel Make +
Noun + Adjective Heat Treatment of Steel.	
	Quantity, Contents
Lubrication 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., Steam Locomotives
Classification.	The Impersonal Passive
Condensation and Condensers.	Passive Verb + By + Noun (agent)
Centrifugal Governors.	Too Much or Too Little
Impulse Turbines.	Instructions (Imperative)
The Petro Engine.	Requirements and Necessity The
Carburation System.	Means (by + Noun or –ing)
The Jet Engine.	Time Statements The
Turbo-Prop Engine.	Function, Duty
Aerofoil.	Alternatives

Evaluation mode:

Exam: 100%.

References:

1. J. Upjohn, S. Blattes, V. Jans, Minimum Competence in Scientific English, Office of University Publications, 1994.
2. AJ Herbert, The Structure of Technical English, Longman, 1972.
3. S. Berland-Delepine, Methodical grammar of modern English with exercises, 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, English: 1000 Words and Expressions from the Press: Vocabulary and Expressions from the Economic, Social and Political World, Fernand Nathan, 2006.

Semester: 2

Teaching unit: UEF 1.2

Subject 1: Mathematics 2

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

Coefficient: 3

Teaching objectives

Students are led, step by step, towards understanding mathematics useful for their university studies. At the end of the course, the student should be able to: solve first and second degree differential equations; solve integrals of rational, exponential, trigonometric and polynomial functions; solve systems of linear equations using several methods.

Recommended prior knowledge

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

Content of the material:

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 basis, transition matrix.

Chapter 2: Systems of Linear Equations **(2 Weeks)**
2-1 Generalities. 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.
Resolution by the Gauss method

Chapter 3: Integrals 3-1 **(4 Weeks)**
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 4-1 **(4 Weeks)**
Ordinary Differential Equations. 4-2 First-Order Differential Equations. 4-3 Second-Order Differential Equations. 4-4 Second-Order Ordinary Differential Equations
constant coefficient.

Chapter 5: Functions of Several Variables 5-1 **(2 Weeks)**
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 corrected exercises, McGraw-Hill.

2- F. Ayres Jr, Theory and Applications of Differential Equations - 560 corrected exercises, McGraw-Hill.

3- J. Lelong-Ferrand, JM 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. Piskunov, Differential and Integral Calculus, Volume 1, Moscow Edition
6- J. Quinet, Elementary course in higher mathematics 3- Integral calculus and series, Dunod.
7- J. Quinet, Elementary course in higher mathematics 4- Differential equations, Dunod.
8- J. Quinet, Elementary course in higher mathematics 2- Usual functions, Dunod.
9- J. Quinet, Elementary course in higher 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 exercises in higher algebra, Moscow Edition.

Semester: 2
Teaching unit: UEF 1.2
Subject 2: Physics 2
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching 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 reminders: (1 week)

1- Elements of length, surface, volume in Cartesian, cylindrical, 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 and Savart's law, Ampere's theorem, Calculation of magnetic fields created by permanent 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 Foundations and Applications, Ed. 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. PA Tipler, G. Mosca; Physics For Scientists and Engineers, 6th ed., WH Freeman Company, 2008.

Semester: 2

Teaching unit: UEF 1.2

Subject 3: Thermodynamics

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

Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

Basic notions of mathematics and general chemistry.

Content of the material:

Chapter 1: Generalities on thermodynamics 1- **(3 Weeks)**
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- Reminders of the laws of ideal gases.

Chapter 2: The 1st principle of thermodynamics: 1. Work, **(3 weeks)**
heat, internal energy, concept of conservation of energy. 2. The 1st principle 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 principle 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 2nd Law of Thermodynamics 1- The 2nd law **(3 weeks)**
for a closed system. 2. Statement of the 2nd law: Entropy of a closed isolated system. 3. Calculation of the variation of 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 Principle 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 Edition.

2. HB Callen, Thermodynamics, Course, Edition John Wiley and Sons,
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. CL Huillier, J. Rous, Introduction to thermodynamics, Dunod Edition.

Semester: 2

Teaching unit: UEM 1.2

Subject 1: Physics 2 Practical Work

VHS: 45h00 (TP: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Mathematics 1, Physics 1.

Content of the material:

5 manipulations minimum (3h00 / 15 days)

- Presentation of measuring instruments and tools (Voltmeter, Ammeter, Rheostat, Oscilloscopes, Generator, etc.).
- Kirchhoff's laws (mesh law, knot law).
- Thévenin's theorem.
- Association and Measurement of inductances and capacities
- Charging and discharging a capacitor
- Oscilloscope
- Practical work on magnetism

Assessment method:

Continuous assessment: 100%

Semester: 2

Teaching unit: UEM 1.2

Subject 2: Chemistry 2 Practical Work

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

Credits: 2

Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Thermodynamics.

Content of the material:

1. Ideal gas laws.
2. Water value of the calorimeter.
3. Specific heat: specific heat of liquid and solid bodies.
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

Teaching unit: UEM 1.2

Subject 3: Computer Science 2

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

Credits: 4

Coefficient: 2

Teaching objectives

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

Recommended prior knowledge

Know how to use the university website, file systems, Windows user interface, programming environment.

Content of the material:

Chapter 1: Indexed Variables **(4 Weeks)**

1- One-dimensional arrays: Representation in memory, Operations on arrays

2- Two-dimensional arrays: Representation in memory, Operations on two-dimensional arrays

Chapter 2: Functions and Procedures **(6 Weeks)**

1- Functions: Types of functions, declaration of functions, function calls

2- Procedures: Concepts of global variables and local variables, simple procedure, procedure with arguments

Chapter 3: Recordings and Files **(5 Weeks)**

1- Heterogeneous data structure

2- Structure of a record (notion of fields)

3- Manipulation of record structures

4- Concept of file

5- File access modes

6- Reading and writing to a file

Computer Science 2:

Plan a certain number of practical exercises to put into practice the programming techniques seen during the course.

- Practical work on applying programming techniques seen in class.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1- Algorithms for Dummies large format Book by John Paul Mueller (Informatiker, USA) and Luca Massaron 2017

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

3- Algorithms: Basic Notions Book by Thomas H. Cormen 2013.

Semester: 2

Teaching unit: UEM 1.2

Subject 4: Presentation Methodology

VHS: 3:00 p.m. (Class: 1 hour)

Credits: 1

Coefficient: 1

Teaching objectives

Provide the basics for a successful oral presentation. Skills to acquire 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.

Content of the material:

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

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

Chapter 3: Plagiarism and Intellectual Property 1- **(3 Weeks)**
Plagiarism: Definitions of plagiarism, sanctions for plagiarism, how to borrow the work of other authors, quotes, illustrations, how to be sure to avoid plagiarism?
2- Writing a bibliography: Definition, objectives, how to present a bibliography, writing the bibliography

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

Assessment method:

Review: 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 dissertation and internship report, l'Etudiant, 2014
4. B. Grange, How to Make a Successful Presentation. How to Prepare Powerful Slides and Communicate Effectively in Public. Eyrolles, 2009.
5. H. Biju-Duval, C. Delhay, All speakers, Eyrolles, 2011.
6. C. Eberhardt, Practical work with PowerPoint. Creating and laying out 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

Subject 1: Careers in Science and Technology 2

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

Credits: 1

Coefficient: 1

Objective of the subject:

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

Recommended prior knowledge

None.

Content of the subject:

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

Definitions and areas of application (Safety of property and people, Environmental problems, Exploration and exploitation of mining resources, etc.)

- Role of the specialist in these areas.

2. Climate Engineering and Transport Engineering sectors: (2 weeks)

- Definitions, areas of application (Air conditioning, Intelligent buildings, Transport safety, Traffic management and road, air, naval transport, etc.)

- Role of the specialist in these areas.

3. Civil Engineering, Hydraulics and Public Works sectors: - **(2 weeks)**

Definitions and areas of application (Construction materials, Major road and railway infrastructures, Bridges, Airports, Dams, Drinking water supply and sanitation, Hydraulic flows, Water resources management, Public works and land use planning, Smart cities, etc.)

- Role of the specialist in these areas.

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

- Definitions and fields of application (Aeronautics, Avionics, Automotive industry, Ports, Dikes, Production of industrial equipment, Steel industry, Metal transformation, etc.)

- Role of the specialist in these areas.

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 analysis (LCA), Carbon footprint, case studies/applications.

7. Sustainable Development and Business: (3 weeks)

Definition of the business 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 business, Means of engagement 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)…), World rankings of the most sustainable companies (Dow Jones Sustainable Index, Global 100, etc.), Studies of

cases of successful/eco-responsible companies in the ST sectors (e.g. SIEMENS, Cisco, Henkel AG & Co, TOTAL, Peugeot, Eni SPA ...).

Personal work of the student for this subject: - Work in groups/ pairs: Reading articles on sustainable development and/or reports from successful and sustainable companies and preparation of summaries of the main actions undertaken in the field of sustainable development.

Examples of documents for reading and summarizing:

- Case of ONA and ENIEM: Kadri, Mouloud, 2009, Sustainable development, business and ISO 14001 certification, Market and organizations vol. 1 (No. 8), p. 201-215 (free online access: http://www.cairn.info/revue-marche-et-organisations-2009-1-page-201.htm)
- Mireille Chiroleu-Assouline. Sustainable development strategies for businesses. Ideas, The Review of Economic and Social Sciences, CNDP, 2006, pp. 32-39 (free online access: http://halshs.archives-ouvertes.fr/hal-00306217/document)
- Web page on TOTAL 's environmental and societal commitments : https://www.total.com/fr/engagement
- Sustainable mobility innovations from 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, Edition: Dunod, 2017.

2- P. Jacquemot and V. Bedin, The encyclopedic dictionary of sustainable development, Edition: Sciences Humaines, 2017.

3- Y. Veyret, J. Jalta and M. Hagnerelle, Sustainable development: All the issues in 12 lessons, Edition: Autrement, 2010.

4- L. Grisel and Ph. Osset, Life Cycle Analysis 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 Analysis: Understanding and Carrying Out an Eco-Assessment, 3rd Edition: PPUR, 2017.

6- G. Pitron and H. Védrine, The rare metal war: The hidden face of the energy and digital transition, Edition: Liens qui libèrent, 2018.

7- Environmental and sustainable development professions, Collection: Parcours, Edition: ONISEP, 2015.

Semester: 2

Teaching unit: UET 1.2

Subject 1: French language 2

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

Credits: 1

Coefficient: 1

Teaching objectives:

This subject aims to develop the following four skills: Oral comprehension, Written comprehension, Oral expression, Written expression through reading and studying texts.

Recommended prior knowledge:

Basic French.

Content of the material:

Below we offer a set of themes that cover fundamental sciences, technologies, economics, social issues, communication, sports, health, etc. The teacher can choose texts from this list to develop them during the course. Otherwise, they are free to address other themes of their choice. The texts can be borrowed from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular magazines, books, websites, audio and video recordings, etc.

For each text, the teacher helps the student develop their linguistic skills: listening, comprehension, and oral and written expression. In addition, they must use this text to identify the grammatical structures they will develop during the same class session. Here, for illustration purposes, we recall 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 subjunctive. The conditional. The imperative.
The food industry	The past participle. The passive form.
The National Employment Agency ANEM	Possessive adjectives, possessive pronouns.
Sustainable development	Demonstratives, Demonstrative pronouns.
Renewable energies	The expression of quantity (several, a few, enough, many, more, less, as much, etc.).
Biotechnology	Numbers and measurements.
Stem cells	The pronouns "who, that, where, whose".
Road safety	Subordinate preposition of time.
The dams	The cause, The consequence.
Water – Water resources	The goal, the opposition, the condition.
Avionics	Comparatives, superlatives.
Automotive electronics	…
Electronic newspapers	
Carbon 14 dating	
Violence in stadiums	
Drugs: a social scourge	
Smoking	
School failure	
The Algerian War	
Social networks	
China, an economic power	
Superconductivity	
Cryptocurrency	
Advertising	
Autism	

Assessment method:

Review: 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 all, Hatier.
5. Collective, Besherelles: Conjugation for all, Hatier.
6. Mr. Grégoire, Progressive French Grammar with 400 exercises, Beginner Level, CLE International, 1997.
7. A. Hasni et al., Training in 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. JM Robert, Difficulties of French, Hachette, 10.
C. Tisset, Teaching the French language at school: Grammar, Spelling and Conjugation, Hachette Education, 2005.
11. J. Bossé-Andrieu, Summary of the Rules of Grammar and Spelling, University Press Quebec, 2001.
12. J.-P. Colin, French made simple, Eyrolles, 2010.
13. Collective, French Assessment Test, Hachette, 2001.
14. Y. Delatour et al., Practical French grammar in 80 cards with corrected exercises, Hachette, 2000.
15. Ch. Descotes et al., The Exerciser: French expression for the intermediate level, Presses Grenoble University, 1993.
16. H. Jaraush, C. Tufts, On the Vif, Heinle Cengage Learning, 2011.
17. J. Dubois et al., The Essentials – Spelling, Larousse, 2009.

Semester: 2

Teaching unit: UET 1.2 Subject 1: English Language 2 VHS: 10:30 p.m. (Course: 1.5 hours)
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.	
Chain Reaction. Reactor Cooling System. Conductor and Conductivity. Induction Motors. Electrolysis. Flow and Metering. Liquid Pumps. Petroleum. Road Foundations. Pavements. for Foundations. Suspension Bridges.	Explanation of Cause Result Conditions (if), Conditions (Restrictive) Eventuality Manner When, Once, If, etc. + Past Participle Liquid It is + Adjective + to As It is + Adjective or Verb + that… Similarity, Difference Rigid In Spite of Although, Piles Formation of Adjectives Phrasal Verbs

Evaluation mode:

Exam: 100%.

References:

1. J. Upjohn, S. Blattes, V. Jans, Minimum Competence in Scientific English, Office of University Publications, 1994.
2. AJ Herbert, The Structure of Technical English, Longman, 1972.
3. S. Berland-Delepine, Methodical grammar of modern English with exercises, 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, English: 1000 Words and Expressions from the Press: Vocabulary and Expressions from the Economic, Social and Political World, Fernand Nathan, 2006.

Semester: 3

Teaching unit: UEF 2.1.1

Subject 1: Mathematics 3

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

Credits: 6

Coefficient: 3

Teaching objectives:

At the end of this course, the student should be able to know the different types of series and their conditions of convergence as well as the different types of convergence.

Recommended prior knowledge

Mathematics 1 and Mathematics 2

Content of the subject:

Chapter 1: Simple and Multiple Integrals 1.1 **3 weeks**

Reminders on the Riemann integral and the calculation of primitives. 1.2 Double and Triple Integrals. 1.3 Application to the calculation of areas, volumes, etc.

Chapter 2: Improper Integrals 2.1 **2 weeks**

Integrals of functions defined on an unbounded interval. 2.2 Integrals of functions defined on a bounded interval, infinite at one end.

Chapter 3: Differential Equations 3.1 **2 weeks**

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 5.1 Definition **3 weeks**

and properties. 5.2 Application to the resolution of differential equations.

Chapter 6: Laplace Transform 6.1 Definition **2 weeks**

and properties. 6.2 Application to the resolution of 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, JM 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. Piskunov, Differential and Integral Calculus, Volume 1, Moscow Edition

6- J. Quinet, Elementary course in higher mathematics 3- Integral calculus and series, Dunod.

7- J. Quinet, Elementary course in higher mathematics 4- Differential equations, Dunod.

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

Semester: 3

Teaching unit: UEF 2.1.1
Subject 2: Waves and Vibrations VHS:

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

Coefficient: 2

Teaching objectives

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

Recommended prior knowledge

Mathematics 2, Physics 1 and Physics 2

Content of the subject:

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

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

Part A: Vibrations

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

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

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

Chapter 4: Free oscillations of two-degree-of-freedom systems 1 week
4.1 Introduction 4.2 Two-degree-of-freedom systems

Chapter 5: Forced Oscillations of Two-Degree-of-Freedom Systems 2 weeks 5.1 Lagrange Equations 5.2 Mass-Spring-Damper System 5.3 Impedance 5.4 Applications

5.5 Generalization to systems with n degrees of freedom

Part B: Waves

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

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

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

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

Assessment method:

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

Bibliographic references:

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

Semester: 3

Teaching unit: UEF 2.1.2

Subject 1: Fundamental Electronics 1

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

Credits: 4

Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge Notions of materials physics and fundamental electricity.

Content of the subject:

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

Chapter 1. Continuous Regime and Fundamental Theorems **3 weeks**

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

Chapter 2. Passive Quadrupoles **3 weeks**

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

Chapter 3. Diodes **3 weeks**

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

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

Chapter 4. Bipolar Transistors **3 weeks**

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

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

Equivalent Schematic, Ideal Op-Amp, Feedback, Op-Amp Characteristics, Basic Operational Amplifier Assemblies: Inverter, Non-Inverter, Adder, Subtractor, Comparator, Follower, Differentiator, Integrator, Logarithmic, Exponential, etc.

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

Bibliographic references:

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

Semester: 3

Teaching unit: UEF 2.1.2

Subject 2: Fundamental Electrical Engineering 1

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

Credits: 4

Coefficient: 2

Teaching objectives :

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

Recommended prior knowledge:

Basic concepts of electricity.

Content of the subject:

Chapter 1. Mathematical reminders on complex numbers (CN) **(1 Week)**

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

Chapter 2. Reminders on the fundamental laws of electricity Continuous **(2 Weeks)**

regime: electric dipole, association of R, C, L dipoles.

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

Transient regime: RL circuit, RC circuit, RLC circuit, charging and discharging of a capacitor.

Chapter 3. Electrical Circuits and Powers Single-phase **(3 Weeks)**

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

Chapter 4. Magnetic Circuits Magnetic **(3 Weeks)**

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

Chapter 5. Transformers Ideal single- **(3 Weeks)**

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

Chapter 6. Introduction to Electrical Machines General **(3 Weeks)**

information on electrical machines. Principle of operation of the generator and the motor.

Power and efficiency balance.

Assessment method:

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

Bibliographic references:

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

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

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

Semester: 3

Teaching unit: UEM2.1

Subject 1: Probability and Statistics

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

Credits: 4

Coefficient: 2

Subject objectives

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

Recommended prior knowledge

Mathematics 1 and Mathematics 2

Content of the material:

Part A: Statistics

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

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

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

Number, Frequency, Percentage.

A.2.2 Cumulative workforce, Cumulative frequency.

A.2.3 Graphical representations: bar chart, pie chart, stick chart.

Polygon of numbers (and frequencies). Histogram. Cumulative curves.

A.2.4 Position characteristics A.2.5

Dispersion characteristics: range, variance and standard deviation, coefficient of variation.

A.2.6 Shape characteristics.

Chapter 3: Two-variable statistical series A.3.1 Data **(3 weeks)**

tables (contingency table). Scatter plot.

A.3.2 Marginal and conditional distributions. Covariance.

A.3.3 Linear correlation coefficient. Regression line and Mayer line.

A.3.4 Regression curves, regression corridor and correlation ratio.

A.3.5 Functional adjustment.

Part B: Probabilities

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

B.1.1 Arrangements

B.1.2 Combinations

B.1.3 Permutations.

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

Algebra of Events

B.2.2 Definitions

B.2.3 Probability spaces

B.2.4 General probability theorems

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

Conditioning,

B.3.2 Independence,

B.3.3 Bayes formula.

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

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

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

Bibliographic references:

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

2. J.-F. Delmas. Introduction to probability calculus and statistics. ENSTA handout, 2008.
3. W.Feller. an Introduction to Probability Theory and its Applications, Volume 1. Wiley & Sons, Inc., 3rd edition, 1968.
4. G. Grimmett, D. Stirzaker, Probability and Random Processes, Oxford University Press, 2nd edition, 1992.

5. J. Jacod and P. Protter, Probability Essentials, Springer, 2000.
6. A. Montfort. Course in mathematical statistics. Economica, 1988.
7. A. Montfort. Introduction to Statistics. Ecole Polytechnique, 1991

Semester: 3

Teaching unit: UEM2.1

Subject 2: Computer Science 3

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

Credits: 2

Coefficient: 1

Subject objectives:

Teach the student programming using easy-to-access software (mainly: Matlab, Scilab, Mapple, etc.). This subject will be a tool for carrying out practical work on numerical methods in S4.

Recommended prior knowledge:

The basics of programming acquired in computer science 1 and 2.

Content of the subject:

TP 1: Presentation of a scientific programming environment (1 Week)

(Matlab, Scilab, etc.)

TP 2: Script files and Data and variable types (2 Weeks)

TP 3: Reading, displaying and saving data (2 Weeks)

TP 4: Vectors and matrices (2 Weeks)

TP 5: Control instructions (for and while loops, if and switch instructions) (2 weeks)

TP 6: Function files (2 Weeks)

TP 7: Graphics (Management of graphics windows, plot) (2 Weeks)

TP 8: Using toolbox (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 Calculation scientist in Python and Scilab scientific preparatory classes 1st and 2nd years, Ellipses, 2010.

Semester: 3

Teaching unit: UEM 2.1

Subject 3: Electronics and Electrical Engineering Practicals

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

Credits: 2

Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge: Basic electronics.

Basic electrical engineering.

Content of the subject:

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

Electronics 1 Practical Work

TP 1: Fundamental theorems **TP 2:**

Characteristics of passive filters

TP 3: Diode / rectification characteristics

TP 4: Stabilized power supply with Zener diode

TP 5: Characteristics of a transistor and operating point

TP 6: Operational amplifiers.

Electrical Engineering Practical Work 1

TP 1: Measurement of single-phase voltages and currents

TP 2: Measurement of three-phase voltages and currents

TP 3: Measurement of active and reactive power in three-phase

TP 4: Magnetic circuits (hysteresis cycle)

TP 5: Tests on transformers

TP 6: Electrical machines (demonstration).

Assessment method:

Continuous assessment: 100%

Bibliographic references:

Semester: 3

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

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

Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

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

Content of the subject:

TP1: Mass – spring

TP2: Simple pendulum
TP3: Torsion pendulum

TP4: Oscillating electrical circuit in free and forced mode

TP5: Coupled pendulums
TP6: Transverse oscillations in vibrating strings

TP7: Grooved pulley according to Hoffmann

TP8: Electromechanical systems (The electrodynamic loudspeaker)

TP9: Pohl's pendulum

TP10: Propagation of longitudinal waves in a fluid.

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

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

Semester: 3

Teaching unit: UED 2.1

Subject 1: State of the art of electrical engineering

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

Credits: 1

Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

None

Content of the subject:

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

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

Assessment method: Final exam: 100%.

Bibliographic references:

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

Semester: 3

Teaching unit: UED 2.1 Subject 2:

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

(Course: 1:30 p.m.)

Credits: 1

Coefficient: 1

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

Recommended prior knowledge: Notions of energy and environment.

Content of the subject:

Chapter 1: Different Energy Resources

Chapter 2: Energy Storage

Chapter 3: Consumption, reserves and developments in energy resources

Chapter 4: The different types of pollution

Chapter 5: Detection and treatment of pollutants and waste

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

Assessment method:

Final exam: 100%.

Bibliographic references: 1-

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

Semester: 3

Teaching unit: UET 2.1

Subject 1: Technical English

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

Credits: 1

Coefficient: 1

Teaching objectives:

This course should enable the student to acquire a sufficiently significant level of language to enable him to use a scientific document and speak about his specialty and his field in English,
at least, with a certain ease and clarity.

Recommended prior knowledge:

English 1 and English 2

Content of the subject:

- Oral comprehension and oral expression, vocabulary acquisition, grammar, etc.
- Nouns and adjectives, comparatives, following and giving instructions, identifying things.
- Use of numbers, symbols, equations.
- Measurements: Length, area, volume, power, etc.
- Describe 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. AJ Herbert, The Structure of Technical English, Longman, 1972.
3. Test of English as a Foreign Language – Preparation Guide, Cliffs, 1991.
4. Cambridge – First Certificate in English, Cambridge books, 2008.
5. K. Wilson, Th. Healy, First Choice, Oxford, 2007.
6. M. Mann, S. Tayore-Knowles, Destination: Grammar & Vocabulary with Answer Key, MacMillan, 2006.
7. P. Charles Brown, Norma D. Mullen, English for Computer Science, Oxford University Press, 1989.
8. Graeme Kennedy, Structure and Meaning in English: A Guide for Teachers, Pearson, 2004.
9. Anne M. Hanson, Brain-Friendly Strategies for Developing Student Writing Skills, 2nd Edition, Corwin Press, 2008.
10. Ann Bridges, How to Pass Higher English, Hodder Gibson-Hachette, 2009.

Semester: 4

Teaching unit: UEF 2.2.1

Subject 1: Hydraulics and pneumatics

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

Credits: 6

Coefficient: 3

Teaching objectives: This course allows the student to be able to study and analyze industrial systems based on hydraulic and pneumatic concepts.

Recommended prior knowledge:

None

Content of the material:

Chapter 1: Introduction to Fluid Mechanics 1 week

1-Definitions: Perfect fluid, Real fluid, Incompressible fluid, Compressible fluid).
2-Physical characteristics: (Density, Volumetric weight, Density, Viscosity)

Chapter 2: Fluid Statics 1-Introduction. 2- **2 weeks**
Concept of pressure at a point of a fluid. 3-Fundamental relationship of hydrostatics. 4-Pascal's theorem. 5-Thrust of a fluid on a vertical wall. 6-Archimedes' theorem.

Chapter 3: Dynamics of Perfect Incompressible Fluids 1-Introduction. 2-Steady **2 weeks**
Flow. 3-Continuity Equation. 4-Concept of Flow Rate. 5-Bernoulli's Theorem (Case of a flow without work exchange). 6-Bernoulli's Theorem (Case of a flow with work exchange)

Chapter 4: Dynamics of Real Incompressible Fluids 1- Introduction. 2- Real **3 weeks**
Fluids. 3- Flow Regimes (Reynolds Number). 4- Pressure Losses: Definition, Singular Pressure Losses, Linear Pressure Losses. 5-Bernoulli's Theorem Applied to a Real Fluid.

Chapter 5: General information on hydraulic and pneumatic circuits 1-General information on **4 weeks**
hydraulic fluids: Different hydraulic types (mineral oil, synthetic oil), Influence of temperature on viscosity, Influence of pressure on viscosity. 2-Filtration (Classification of the pollution state of a hydraulic fluid, Consequence of poor filtration, Control of the pollution level, Filtration technique). 3-The components of a hydraulic circuit (The single and double-acting cylinder, The distributors, Limitation and regulation of flow, Limitation and regulation of pressure, The pumps)

Chapter 6: General information on pneumatic circuits 1-General **3 weeks**
information (composition of air, Unit of pressure, Unit of power). 2-Production of compressed air. 3-Energy treatment: (Compressed air treatment, Compressed air filtration level). 4-Conditioning modules: (The different components, Operating principle - filters, pressure regulators, lubricators, soft starters-5- The main power components. 6-Distributors.

Assessment method:

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

Bibliographic references:

1- R. Comolet, Experimental Fluid Mechanics, Volumes 1, 2 and 3, Edition Masson et Cie.
2- R. Ouziaux, Applied Fluid Mechanics, Dunod Edition, 1978
3- BR Munson, Fundamentals of fluid mechanics, Wiley & Sons.
RV Gilles, Fluid Mechanics and Hydraulics: Courses and Problems, Schaum Series, Mc Graw Hill, 1975.

4- CT Crow, Engineering fluid mechanics, Wiley & sons
5- VL Streeter, Fluid mechanics, McGraw Hill
6- S. Amiroudine, Fluid Mechanics: Course and Corrected Exercises, Dunod Editions
7- M.Portelli, Industrial hydraulics technology, course and solved exercises, Educalivres, 2005.

Semester: 4

Teaching unit: UEF 2.2.1

Subject 2: Combinatorial and sequential logic

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

Credits: 4

Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge None.

Content of the subject:

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

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

Variables and Logical Functions (OR, AND, NOR, NAND, XOR). Laws of Boolean Algebra. De Morgan's Theorem. Complete and Incomplete Logical Functions. Representation of Logical Functions: Truth Tables, Karnaugh Tables. Simplification of Logical Functions: Algebraic Method, Karnaugh Method.

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

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

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

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

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

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

Chapter 5: Combinational Comparison Circuits **2 weeks**

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

Chapter 6: Flip-Flops **2 weeks**

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

Chapter 7: Counters **2 weeks**

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

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

Chapter 8. Registers **1 Week**

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

Assessment method:

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

Bibliographic references:

1- J. Letocha, Introduction to Logic Circuits, McGraw Hill Edition.
2- JC Lafont, Course and problems in digital electronics, 124 exercises with solutions, Ellipses.
3- R. Delsol, Digital Electronics, Volumes 1 and 2, Edition Berti 4- P.
Cabanis, Digital Electronics, Edition Dunod.
5- M. Gindre, Combinatorial Logic, Edition Ediscience.
6- H. Curry, Combinatory Logic II. North Holland, 1972
7- R. Katz, Contemporary Logic Design, 2nd ed. Prentice Hall, 2005.
8- M. Gindre, Digital Electronics: Combinational Logic and Technology, McGraw Hill, 1987
9- C. Brie, Combinatorial and Sequential Logic, Ellipses, 2002.
10- JP. Ginisti, Combinatorial Logic, Paris, PUF (coll. “What do I know?” n°3205), 1997.
11- JL. Krivine, Lambda-calculus, types and models, Masson, 1990, chap. Combinatorial logic, English translation available on the author's website.

Semester: 4

Teaching unit: UEF 2.2.2

Subject 1: Digital methods VHS: 45h00

(Lecture: 1h30, Tutorial: 1h30)

Credits: 4

Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge:

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

Content of the subject:

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

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

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

Chapter 3. Function Approximation: (2 Weeks)

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

Chapter 4. Digital Integration (2 Weeks)

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

Chapter 5. Solving Ordinary Differential Equations (Initial Condition or Cauchy Problem) (2 Weeks)

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

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

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

Chapter 7. Method of approximate solution of systems of linear equations

(2 Weeks)

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

Assessment method:

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

Bibliographic references:

1. C. Brezinski, Introduction to the practice of numerical calculation, Dunod, Paris 1988.
2. G. Allaire and SM Kaber, Numerical Linear Algebra, Ellipses, 2002.

3. G. Allaire and SM 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, SP Norsett and G. Wanner, Solving Ordinary Differential Equations, Springer, 1993.
9. PG Ciarlet, Introduction to matrix numerical analysis and optimization, Masson, Paris, 1982.

Semester: 4

Teaching unit: UEF 2.2.2

Subject 2: Strength of Materials

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

Credits: 4

Coefficient: 2

Teaching objectives:

Know the methods of calculating the resistance of construction elements and determine the variations in the shape and dimensions (deformations) of the elements under the action of loads.

Recommended prior knowledge:

Analysis of functions; rational mechanics.

Content of the material:

Chapter 1: Introductions and Generalities

Goals and hypotheses of the resistance of materials, Classification of solids (beam, plate, shell),
Different types of loads, Connections (supports, embedments, hinges), General principle of equilibrium – Equilibrium equations,
Principles of cutting – Reduction elements, Definitions and sign conventions of: Normal force N, Shear force T, Bending moment M

Chapter 2: Traction and Compression

Definitions, Normal tensile and compressive stress, Elastic deformation in tension/compression, Tensile/compressive strength condition.

Chapter 3: Shear

Definitions, Simple shear – pure shear, Shear stress, Elastic shear deformation, Shear strength condition.

Chapter 4: Geometric characteristics of straight sections

Static moments of a cross section, Moments of inertia of a cross section, Formulas for transforming moments of inertia.

Chapter 5: Twisting

Definitions, Tangential or sliding stress, Elastic torsional deformation, Condition of resistance to torsion.

Chapter 6: Simple Plane Bending

Definitions and assumptions, Shear forces, bending moments, Diagram of shear forces and bending moments, Relationship between bending moment and shear force, Deformation of a beam subjected to simple bending (arrow), Calculation of stresses and dimensioning.

Assessment method:

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

Bibliographic references:

1- F. Beer, Mechanics for Engineers – Statics, McGraw-Hill, 1981.
2- P. Stepine, Resistance of materials, Editions MIR; Moscow, 1986.
3- W. Nash, Strength of Materials 1, McGraw-Hill, 1974.
4- S. Timoshenko, Resistance of materials, Dunod, 1986.

Semester: 4

Teaching unit: UEM 2.2

Subject 1: Practical work on electrical and electronic measurements

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

Credits: 2

Coefficient: 1

Teaching objectives:

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

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

Content of the subject:

Electrical and electronic measurements:

TP No. 1: Resistance measurement:

Measure resistance using the following 5 methods: voltammetric, ohmmeter, Wheatstone bridge, comparison and substitution.

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

TP No. 2: Inductance measurement:

Carry out the measurement of inductances using the following 3 methods: voltammetric, Maxwell bridge, resonance.

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

TP No. 3: Capacity measurement:

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

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

TP No. 4: Phase shift measurement:

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

TP No. 5: Single-phase power measurement:

Measure the resistance using the following 5 methods: wattmeter, Cosÿmeter, three voltmeters, three ammeters, power sensor.

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

TP No. 6: Three-phase power measurement:

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

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1- M. Cerr, Industrial Instrumentation: T.1, Tec and Doc Edition.

2- M. Cerr, Industrial Instrumentation: T.2, Tec and Doc Edition.

3- P. Oguic, Measurements and PC, ETSF Edition.

4- D. Hong, Electrical Circuits and Measurements, Dunod, 2009.

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

Internet sources:

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

Semester: 4

Teaching unit: UEM 2.2

Subject 2: Logic Practical Work

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

Credits: 1

Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge: Combinatorial and Sequential Logic.

Content of the subject:

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

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

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

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

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

TP5: Study and creation of a combinational logic circuit
Complete study (Truth table, Simplification, Logic diagram, Practical assembly and Tests) of a combinational circuit based on specifications.

TP6: Study and creation of meter circuits
Incomplete asynchronous counter circuits using flip-flops, Irregular cycle synchronous counter circuits using flip-flops

Assessment method:

Continuous assessment: 100%

Bibliographic references:

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

Semester: 4

Teaching unit: UEM 2.2

Subject 3: Hydraulics and Pneumatics VHS:

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

Credits: 2

Coefficient: 1

Teaching objectives:

The student is required to be able to use the tools necessary to install certain special functions of hydraulic and pneumatic circuits used in controlling industrial systems, particularly electromechanical systems.

Recommended prior knowledge:

Hydraulics and pneumatics.

Content of the material:

TP No. 1: Verification of the Bernoulli relation

TP No. 2: Determination of pressure losses in a pipeline

TP No. 3: Study of components and determination of hydraulic parameters

TP No. 4: Adjusting the speed of a single and double-acting hydraulic cylinder

TP No. 5: Use of a hydraulic accumulator

TP No. 6: Study of components and determination of pneumatic parameters

TP No. 7: Control of a single and double-acting pneumatic cylinder

Air motor speeds

Note: It is up to the subject managers to choose at least 5 manipulations depending on the availability of the material.

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1- R. Comolet, Experimental Fluid Mechanics, Volumes 1, 2 and 3, Edition Masson et Cie.

2- R. Ouziaux, Applied Fluid Mechanics, Dunod Edition, 1978

3- BR Munson, Fundamentals of fluid mechanics, Wiley & Sons.

4-RV Gilles, Fluid Mechanics and Hydraulics: Courses and Problems, Schaum Series, Mc Graw Hill, 1975.

5- CT Crow, Engineering fluid mechanics, Wiley & sons

6- VL Streeter, Fluid mechanics, McGraw Hill

7- S. Amiroudine, Fluid Mechanics: Course and Corrected Exercises, Dunod Editions

8- M.Portelli, Industrial hydraulics technology, course and solved exercises, Educalivres, 2005.

Semester: 4

Teaching unit: UEM 2.2

Subject 4: Digital Methods VHS Practical Work:

10:30 p.m. (Practical work: 1.5 hours)

Credits: 2

Coefficient: 1

Teaching objectives:

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

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

Content of the subject:

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

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

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

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

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

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1. José Ouin, Algorithmics and numerical calculation: Solved practical work and programming with Scilab and Python software, Ellipses, 2013.

2. Bouchaib Radi, Abdelkhalak El Hami, Mathematics with Scilab: guide to calculation, programming, graphic representations; conforms to the new MPSI program, Ellipses, 2015.

3. Jean-Philippe Grivet, Applied numerical methods: for scientists and engineers, EDP sciences, 2009.

Semester: 4

Teaching unit: UEM 2.2

Subject 5: Technical drawing VHS:

10:30 p.m. (practical work: 1:30 p.m.)

Credits: 2

Coefficient: 1

Teaching objectives

This course will allow students to acquire the principles of representing parts in industrial design. Furthermore, this subject will allow the student to represent and read plans.

Prerequisite knowledge

In order to follow this course, basic knowledge of the general principles of drawing is required.

Content of the material

Chapter 1: General Information. **2 weeks**

1.1 Usefulness of technical drawings and different types of drawings.
1.2 Drawing materials.
1.3 Standardization (Types of lines, Writing, Scale, Drawing format and folding, Title block, etc.).

Chapter 2: Elements of descriptive geometry 2.1 **6 Weeks**
Notions of descriptive geometry.
2.2 Orthogonal projections of a point - Drawing of a point - Orthogonal projections of a straight line (any and particular) - Drawing of a straight line - Traces of a straight line - Projections of a plane (Any and particular positions) - Traces of a plane.
2.3 Views: Choice and arrangement of views – Dimensioning – Slope and taper – Determination there of 3rd view from two given views.
2.4 Method of executing a drawing (layout, 45° line, etc.) Application exercises and assessment (TP)

Chapter 3: Perspectives **2 weeks**
Different types of perspectives (definition and purpose). Application exercises and assessment (TP).

Chapter 4: Sections and Cuts **2 weeks**
4.1 Sections, standardized representation rules (hatching).
4.2 Projections and sections of simple solids (Projections and sections of a cylinder, a prism, a pyramid, a cone, a sphere, etc.).
4.3 Half-cut, Partial cuts, Broken cuts, Sections, etc.
4.4 Technical vocabulary (terminology of machined shapes, profiles, piping, etc. Application exercises and assessment (TP).

Chapter 5: Quotation **2 weeks**
5.1 General principles. 5.2 Quotation, tolerance and adjustment. Application exercises and evaluation (TP).

Chapter 6: Concepts on definition and assembly drawings and nomenclatures.

1 Week

Application exercises and assessment (TP).

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1. Industrial designer's guide Chevalier A. Hachette Technique Edition;
2. Technical drawing 1st part descriptive geometry Felliachi d. and Bensaada s. Edition OPU Algiers;
3. Technical drawing 2nd part industrial drawing Felliachi d. and bensaada s. Edition OPU Algiers;
4. First notions of technical drawing Andre Ricordeau Edition Andre Casteilla;
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Recommendation : A large part of the practical work should be in the form of personal work at home.

Semester: 4

Teaching unit: UED 2.2

Subject 1: Energy Conversion Systems VHS: 10:30 p.m. (Course: 1.5 hours)

Credits: 1

Coefficient: 1

Teaching objectives:

Review the different types of energy converters and in particular electromechanical energy conversion systems.

Recommended prior knowledge:

Electrotechnics 1, Electrotechnics 2.

Content of the material:

Chapter 1: Energy and Energy Variables

Energy and forms of energy, Units of energy and power, Magnetostatics: Production of torque and force, Dimensioning of the power chain, Power in sinusoidal regime.

Chapter 2: Electromechanical Energy Conversion

General: Technological structure of electromechanical converters (Theoretical models of rotating converters), Classification of converters, Variation of the electromagnetic energy of the system, Powers and torques.

Chapter 3: Other Forms of Conversion

Photovoltaic and solar energy conversion (Photovoltaic effect, principle and technology, Efficiency of solar panels), Heat energy conversion, Combustion engines.

Assessment method:

Final exam: 100%.

Bibliographic references:

(Books and handouts, websites, etc.)

Semester: 4

Teaching unit: UED 2.2

Subject 2: Concepts of electrical and electronic measurements

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

Credits: 1

Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge:

- General Electricity
- Fundamental laws of physics

Content of the material:

Chapter 1: Basic concepts of measurement Definition **5 weeks**
and purpose of a measurement, Electrical quantities and units of measurement, Dimensional equations, Usual characteristics of signals (instantaneous, average and effective values), Range of currents used in electronics and electrical engineering (voltage, current, power), Measurement characteristics (precision, resolution, fidelity, etc.), Measurement errors: Absolute uncertainty, Relative uncertainty, Rules for calculating uncertainties, presentation of a measurement result. Quality of a measuring device, Error and accuracy class.

Chapter 2: Classification of electrical and electronic measuring devices 3 weeks
The different types of measuring devices: Review and briefly explain the usefulness, specificities and use of each of these devices: Ammeter, Voltmeter, Ohmmeter, Wattmeter, Frequency meter, Function generators, Logic probe, etc.

Chapter 3: Operating principles of measuring devices Analog measuring **2 weeks**
devices: Operating principle
Digital measuring devices: Operating principle
Cathode ray oscilloscope: Operating principle.

Chapter 4: Electrical measurement methods **4 weeks**
Measurement of voltages and currents, Methods of measuring resistances, Methods of measuring impedances, Methods of measuring phase shifts, Methods of measuring frequencies, Methods of measuring direct and alternating power.

Chapter 6: Measurement in Industry **1 week**
Measurement problems in the industrial environment. Equipment installation and environment.
Choice of devices used in industry.

Assessment method:

Exam: 100%.

Bibliographic references:

1- M. Cerr, Industrial Instrumentation: T.1, Tec and Doc Edition.
2- M. Cerr, Industrial Instrumentation: T.2, Tec and Doc Edition.
3- P. Oguic, Measurements and PC, ETSF Edition.
4- D. Hong, Electrical Circuits and Measurements, Dunod, 2009.
5- W. Bolton, Electrical and Electronic Measurement and Testing, 1992.
6- A. Fabre, Electrical and electronic measurements, OPU, 1996.

7- G. Asch, Sensors in industrial instrumentation, Dunod edition, 2010.
8- L. Thompson, Electrical Measurements and Calibration: Fundamentals and Applications, Instrument Society of America, 1994.
9- JP Bentley, Principles of Measurement Systems, Pearson Education, 2005.
10- J. Niard, Electrical measurements, Nathan, 1981.
11- P. Beauvilain, Electrical and Electronic Measurements.
12- M. Abati, Applied electronic measurements, Delagrave Techniques and Standardization Collection.
13- P. Jacobs, Electrical Measurements, Dunod Edition.
14- A. Leconte, Measurements in electrotechnics (Document D 1 501), The engineering techniques.

Internet sources:

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

Semester: 4

Teaching unit: UET 2.2

Subject 1: Expression and Communication Techniques

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

Coefficient: 1

Teaching objectives:
This teaching aims to develop the student's skills, on a personal or professional level, in the field of communication and expression techniques.

Recommended prior knowledge
Languages (Arabic; French; English)

Content of the subject:

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

Chapter 1: Research, analyze and organize information Identify **3 weeks**
and use locations, tools and documentary resources, Understand and analyze documents, Create and update documentation.

Chapter 2: Improving the ability to express oneself **3 weeks**
Take into account the communication situation, Produce a written message, Communicate orally, Produce a visual and audiovisual message.

Chapter 3: Improving communication skills in interaction situations
3 weeks
Analyze the interpersonal communication process, Improve face-to-face communication ability, Improve group communication ability.

Chapter 4: Developing autonomy, organizational and communication skills within the framework of a project approach Positioning oneself **6 weeks**
in a project and communication approach, Anticipating action, Implementing a project: Presentation of a report on practical work (Homework).

Assessment method:
Final exam: 100%.

Bibliographic references:
1- Jean-Denis Commeignes 12 methods of written and oral communication, 4th ed., Dunod 2013.
2- Denis Baril, Techniques of written and oral expression, Sirey, 2008.
3- M. Dubost Improving your written and oral expression: all the keys, Ellipses Edition 2014.

Semester: 5

Teaching unit: UEF 3.1.1
Subject: Machine elements

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

Coefficient: 3

Teaching objectives:
To provide students with scientific and technological training in the field of mechanics through knowledge of standard machine elements from the point of view of standardization and operation for the transmission of mechanical power as well as the causes which can lead to operating faults.

Recommended prior knowledge: Industrial Design,

RDM, mechanical manufacturing processes.

Content of the subject:

Chapter 1: Basic Mechanical Functions **(1 week)**

Definitions – Standardization, Criteria for choosing a technological solution, Example of study Reliability, Safety Factor, Adjustments.

Chapter 2. Threaded assemblies **(3 weeks)**
Screws, bolts, studs, resistance calculation (shear, matting, bending, tightening of a hyperstatic system)

Chapter 3: Non-dismountable assemblies **(3 weeks)**
Riveting (different types of rivets and rivets, sizing calculations, etc.)
Welding (Different types of welds, Calculation of welds: end, lap, joint cover, cylindrical, dynamic load etc.)

Chapter 4: Gears - Study of geometric cutting characteristics (3 weeks)
Cylindrical gear (straight and helical teeth), Bevel gear (straight and helical teeth), worm screw.

Chapter 4: **Motion transmission - Calculation and dimensioning** • Bearings and thrust bearings **(3 weeks)**

- Belts and Chains….

Chapter 5: Reducers and Gearboxes **(2 weeks)**

- Kinematic study of a speed reducer
- Kinematic study of a gearbox

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. Buchet Jean David Morvan. *The Gears* Ed.: Delcourt G. Productions 01/2004
2. Georges Henriot. *The Gears* Ed.: Dunod
3. Alain Pouget, Thierry Berthomieu , Yves Boutron, Emmanuel Cuenot. *Structures and Mechanisms - Mechanical construction activities* Ed. Hachette Technique
4. R. Quatremer, JP Trotignon, M. Dejans, H. Lehu. *Summary of Mechanical Construction,* Volume 1, *Projects-studies, components, standardization,* AFNOR, NATHAN 2001.

5. R. Quatremer, JP Trotignon, M. Dejans, H. Lehu. *Summary of Mechanical Construction, Volume 3, Projects-calculations, dimensioning, standardization,* AFNOR, NATHAN 1997.
6. Youde Xiong, Y. Qian, Z. Xiong, D. Picard. *Mechanical Form, Construction Parts,* EYROLLES, 2007.
7. Jean-Louis FANCHON. *Guide to Mechanics,* NATHAN, 2008.
8. Francis ESNAULT. *Mechanical construction, Power transmission, Volume 1, Principles and Ecodesign,* DUNOD, 2009.
9. Francis ESNAULT. *Mechanical construction, Power transmission, Volume 2, Applications,* DUNOD, 2001.
10. Francis ESNAULT, DUNOD. *Mechanical construction, Power transmission, Volume 3, Power transmission power by flexible links,* 1999.
11. Bawin, V. and Delforge, C., *Mechanical Construction ,* Original edition: G. Thome, Liège, 1986.
12. M. Szwarcman. *Elements of machines,* Lavoisier edition 1983
13. WL Cleghorn. *Mechanics of machines,* Oxford University Press, 2008.

Semester: 5

Teaching unit: UEF 3.1.1

Subject: Organization and methods of maintenance

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

Coefficient: 2

Teaching objectives:

The student must understand the concepts of maintenance, the organization and methods used as well as the necessary documents and mathematical tools.

Recommended prior knowledge: Machine elements, RDM, electrical engineering, electronics

Content of the material:

Chapter 1. Definition of maintenance (1 Week)

General definition of maintenance, AFNOR definition of maintenance.

Chapter 2. Types of maintenance (2 Weeks)

Preventive maintenance, corrective maintenance, implementation and optimization of corrective maintenance (Fault diagnosis, preparation of interventions, carrying out corrective actions related to technologies (Mechanical, electrical, pneumatic and hydraulic), updating and enrichment of the resources concerned by the intervention.

Chapter 3. Global approach to the maintenance of the production system (2 Weeks)

Chapter 4. Maintenance organization and structures (2 Weeks)

Chapter 5. Techniques used in maintenance (4 Weeks)

Analysis of failure modes of their effects and their criticality FMEA, troubleshooting flowcharts, oil analysis, vibration analysis, reliability, intrinsic and operational reliability, system reliability, reliability and maintenance, maintainability, system availability.

Chapter 6. Relationships and interfaces with other company functions (2 weeks)

Chapter 7. (Re)organization of maintenance (2 weeks)

(Re)organization of services concerned by maintenance activities, development of maintenance management procedures.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. Jean-Pierre Vernier, François Monchy. “Maintenance: Methods and Organizations”, 3rd edition Dunod, 2010.
2. Jean-Pierre Vernier, François Monchy. “Maintenance: Methods and organizations for better productivity”, 3rd edition Dunod, 2012.
3. D. Boitel, C. Hazard. “Maintenance Guide”, Elisabeth Ponard Edition, April 1990.
4. JM Auberville. “Industrial maintenance: from basic maintenance to safety optimization”, edition Ellipses, June 2004.

5. G. Zwingelstein. “Reliability-based maintenance”, Hermes edition, 1996.
6. J. P Vernier. “Maintenance function”, A 8300 Engineering techniques.
7. JM Bleux, JL Fanchon. “Maintenance: Automated Production Systems”, Nathan edition, January 2000.
8. FD X60-000, “Industrial Maintenance: Maintenance Function”, French Standardization. May 2002.

Semester: 5

Teaching unit: UEF 3.1.2

Subject: Applied Electronics

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

Credits: 4

Coefficient: 2

Teaching objectives:

Discover basic electronic functions, understand their operating principles, learn to model them, be able to identify them in a complex electronic diagram.

Recommended prior knowledge: Fundamental Electronics 2.

Content of the subject:

Chapter 1. Differential and operational amplifiers Definition, example of differential amplifier, common and differential mode voltages and gains, differential amplifier with bipolar transistors Operational amplifiers, Principle, Equivalent diagram, Ideal op-amp, Feedback, Characteristics of the op-amp, Basic assemblies of the operational amplifier: Inverter, Non-inverter, Adder, Comparator, Follower, Differentiator, Integrator, Logarithmic, etc. **(3 Weeks)**

Chapter 2. Field Effect Transistors Description, field effect (JFET/MOSFET), operating principle, polarization, operating regimes, characteristic networks, quiescent point, static charge line, common source, common drain and common gate amplifiers. **(3 Weeks)**

Chapter 3. Power Amplifiers Definitions, dynamic load curve, output signal dynamics, efficiency, class A power amplifiers, class B power amplifiers, push-pull amplifiers, class C power amplifiers. **(3 Weeks)**

Chapter 4. Counter Reaction (CR) Properties of feedback, classification of CR assemblies, series-series CR, parallel-parallel CR, parallel-series CR, series-parallel CR. **(3 Weeks)**

Chapter 5. Sinusoidal Oscillators Introduction, closed loop systems, oscillation conditions, frequency stability, amplitude stability and stability criteria. Different types of sinusoidal oscillators: Harmonic oscillators, RC oscillators, LC oscillators and quartz oscillators. **(3 Weeks)**

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1. AP Malvino , “Principle of electronics”, Ediscience.
2. J. Millman. “Microelectronics”, Ediscience.
3. M. Dubois, “Basic electronic components”, Université Laval, 2006.
4. M. Girard, “Discrete active components”. Volume 2: Field effect transistors, Ediscience.
5. Ch. Gentili, “Microwave Amplifiers and Oscillators,” Masson.
6. F. Milsant, “Electronics Problems”, Chihab-Eyrolles, 1994.

Semester: 5

Teaching unit: UEF 3.1.2

Subject 1: Applied electrical engineering

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

Credits: 4

Coefficient: 2

Teaching objectives:

Master the calculation of single-phase and three-phase powers, know the different coupling modes, determine the elements of equivalent models, master the operation of different machines.

Recommended prior knowledge: Basic

knowledge of applied electricity, fundamental electrical engineering1.

Content of the material:

Chapter 1. Reminders on magnetostatics and magnetic circuits **(1 Week)**

Chapter 2. Transformer General **(3 Weeks)**
information, operating principle of the single-phase transformer, impedance matching, the real transformer, transformer in the Kapp approximation, evaluation of the voltage drop in the secondary, energy balance and efficiency, three-phase transformer, different types of coupling and hourly index.

Chapter 3. Direct current machines General **(4 Weeks)**
information, operating principle (Constitution, Direct current generator), characteristic equations, different excitation modes, direct current motor (operating principle, starting, braking and speed adjustment of motors), energy balance and efficiency.

Chapter 4. Synchronous machines General **(4 Weeks)**
information, operating principle of the machine, rotating field, operation as an alternator, study of the different operating diagrams of the alternator, synchronous motors.

Chapter 5. Asynchronous machines **(3 Weeks)**
Operating principle (Construction of asynchronous machines, equations and equivalent single-phase diagram), simplified circle diagram, energy balance and efficiency, operation as a generator and brake, different types of motors, starting of asynchronous motors, speed adjustment of asynchronous motors.

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1- Jacques Lesenne, Francis Notelet and Guy Seguier, “Introduction to Advanced Electrical Engineering”, Technique et Documentation, 1981.
2- Pierre Mayè. “Industrial electric motors”, Dunod edition, 2005.
3- R. Annequin and J. Boutigny. “Physical Sciences Course: Electricity”, Volume 3, Vuibert edition, Paris.
4- M. Kuznetsov. “Foundations of electrical engineering”.
5- H. Lumbroso. “Problems solved on electrical circuits”, Dunod edition.

6- JP Perez, R. Carles and R. Fleekinger, “Electromagnetism Foundations and Applications”, 3rd Edition, 1997.
7- A. Fouillé, “Electrotechnics for the Use of Engineers”, Dunold edition, 1963.
8- M. Kostenko L. Piotrovsky. “Electrical Machines”, Volumes 1 and 2, MIR Edition, Moscow, 1979.
9- Marcel Jufer. “Electromechanics, Polytechnic and University Presses of Romandie”, Lausanne, 2004.
10- AE Fitzgerald, Charles, s Kingsley, Jr, Stephen D. Umans. “Electric Machinery”, McGraw-Hill Higher Education, 2003.

11- Edminster, “Theory and applications of electric circuits”, Mc.Graw.Hill.

Semester: 5

Teaching unit: UEM 3.1

Subject 2: Practical work on Computer-Aided Maintenance Management

VHS: 37h30 (Lecture: 1h30, Practical work: 1h00)

Credits: 3

Coefficient: 2

Teaching objectives:

Better appreciate the contribution of IT tools in the application of maintenance operations.

Recommended prior knowledge: Workshop,
Maths and Physics from L1 and L2.

Content of the material:

TP1- Computer-assisted maintenance management (CMMS)
General information, possible advantages of CMMS, constraints and suggestions of CMMS, conditions for success, development of a possible (re)organization plan.

TP2- Importance of maintenance organization Structure and
organization of maintenance, installations affected by CMMS, development of the possible (re)organization plan.

TP3- The maintenance dashboard

TP4- Computerization of the maintenance service

TP5- Objectives and profitability of CMMS

TP6- Implementation phases

TP7- CMMS software Features:
work management, preventive and curative work, stock management, dashboard.

TP8- Practical demonstration with CMMS software

TP9 - Practical case studies

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic reference:

Jean-Pierre Vernier. “Maintenance and CMMS: Dashboards, Organization and Related Procedures,” 2010.

Semester: 5

Teaching unit: UEM 3.1

Subject 3: Practical work in applied electronics and electrical engineering

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

Credits: 2

Coefficient: 1

Teaching objectives:

To give students the opportunity to create electronic assemblies on a breadboard and then validate their operation using measuring devices. To understand and assimilate the fundamental laws of electrical engineering, the operation of transformers and motors.

Recommended prior knowledge: Fundamental Electronics 2, Fundamental Electrotechnics 2.

Content of the subject:

Note: It is up to the person in charge of the practical work subject to choose 2 to 3 practical work from the two groups of practical work relating to the two subjects.

Part 1: Applied Electronics

TP1-Study of the FET and MOS field effect transistor amplifier

Characterization of the FET transistor and amplification, characterization of the MOS transistor and amplification.

TP2- Power amplifiers Study of the Class A power amplifier, study of the Class B power amplifier, study of the Class AB power amplifier, study of the Class C power amplifier, study of the Push-Pull Class power amplifier.

TP3- Sinusoidal oscillators

RC oscillator study, LC oscillator study, Hartley oscillator study, Colpitts oscillator study.

Part 2: Applied Electrical Engineering

TP1-No-load, on-load and short-circuit tests of a single-phase transformer

TP2- Load test of a three-phase transformer

TP3- Characteristics of a direct current generator

Shunt and separate excitation, self-priming.

TP4- Characteristics of a direct current motor

Shunt and series excitation, starting rheostat.

TP5- Characteristics of a synchronous machine

Survey of V curves.

TP6- Load characteristics of an asynchronous motor.

TP7- Coupling an alternator to the network.

Assessment method:

Continuous assessment: 100%.

Bibliographic references :

1. PA Malvino, DJ Bates, “Principles of Electronics”, Dunod Edition, 2008.
2. C. Cimelli, R. Bourgeron. “Electronics Technician’s Guide”, Hachette Edition, 2004.
3. Websites: http://www.elektronique.fr/, http://etronics.free.fr .
4. D. Bareille, L. Moisson, C. Garnier. “Electrotechnics in 28 files”, Express sciences collection, 2008.
5. L. Lasne. “Electrotechnics”, Sciences sup-Lavoisier Collection, 2008.
6. DF Warne. “Electrical Engineering”, Technical & Engineering Collection-EEA-Lavoisier series, 2007.
7. C. Francois. “Electrical engineering exercises & corrected problems in electrical engineering & “Power Electronics Volume 2”, Editions Lavoisier, 2006.
8. D. Bareille, JP Daunis. “Electrotechnics: transformers & rotating machines”, Sciences Sup-Lavoisier Collection, 2006.

Semester: 5

Teaching unit: UEM 3.1
Subject 4: Industrial design and CAD

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

Coefficient: 1

Teaching objectives:

This course complements the S4 technical drawing course and will enable students to acquire the principles of standardized representation of mechanical parts known as industrial drawing.

Furthermore, this subject will allow the student to represent and read plans of mechanisms and machines. It also aims to improve the student's graphic imagination in order to master this universal language of communication between technicians. Finally, it prepares the student for the proper use of the CAD-CAM tool.

Recommended prior knowledge: Technical drawing,

General technology and Conventional mechanical manufacturing processes.

Content of the material:

Chapter 1: Basic Mechanical Functions (3 weeks)

Mechanical connections (elementary connection, connection character, connection mode, connection realization). Centering and orientation function (rotational guidance, translational guidance, functional dimensioning, adjustments, technical specifications (symbolization).

Chapter 2: **Drawing Reading (3 weeks)**

Sketches, dimensions, kinematic diagrams, general drawing, definition drawing, exploded representation

Chapter 3: Analysis of a drawing (5 weeks)

Assembly of bearings, thrust bearings, joints, plain bearings, obstacles, toothed wheels, lubrication function, sealing, rib chains.

Chapter 4: Application: CAD of a mechanical system (4 weeks)

Production of various parts, assembly including the use of the element library (bearings, screws, etc.). Drawing up (tolerances, functional clearances, adjustments, etc.).

Assessment method:

Continuous assessment: 100%.

Semester: 5

Teaching unit: UEM 3.1

Subject 5: Practical work Metrology and assembly

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

Credits: 2

Coefficient: 1

Teaching objectives:

The metrology and assembly workshop practical work will allow students to familiarize themselves with the different metrology instruments (reading and control) as well as the assembly workshop tools.

Recommended prior knowledge:

Courses in Metrology, Applied Mathematics, Technical Drawing

Content of the material:

Part A: Metrology

TP1 (in two **TPs) - Calibration of length measuring and control devices**
Vernier caliper, Palmer, comparator and depth gauge), concepts of calibration, errors and measurement uncertainty.

TP2- Control of inclinations, angles and cones.

TP3-Thread and gear inspection

TP4-Control of geometric shape tolerances:
circularity, cylindricity, straightness, flatness, parallelism, eccentricity, etc.

TP5-Roughness and surface condition control

TP6-Use of special control devices

Part B: Assembly

TP7-Permanent assemblies – Welding – gluing – riveting

TP8-Dismountable assemblies – by screws – Keying – Splines – pins

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1. “The practical guide to metrology in the workshop” – from the Mediterranean Quality Institute, 2011.
2. “The practical guide to metrology in business” – from the Mediterranean Quality Institute, 2011.
3. “Practical guide to tools for mastering your metrology” – from the Mediterranean Quality Institute, 2012.

Semester: 5

Teaching unit: UED 3.1
Subject 1: Heat Transfer Elements

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

Coefficient: 1

Teaching objectives:
Evaluate conducted, convected, or radiated flows in different situations. Be able to model a thermal problem and solve it in stationary cases and simple geometries. Be able to make the right choice of materials for any thermal application.

Recommended prior knowledge: Thermodynamics and mathematics from L1 and L2.

Content of the material:

Chapter 1. Heat Conduction (7 Weeks)
Introduction to heat transfer and its position with respect to thermodynamics, basic laws of heat transfer, Fourier's law, thermal conductivity and orders of magnitude for common materials. Discussion of the parameters on which thermal conductivity depends, energy equation, simplifying assumptions, and the different forms, spatial and initial boundary conditions, the four linear conditions and their practical significance, some solutions to the heat equation (in Cartesian, cylindrical and spherical coordinates with linear and steady-state conditions). Steady conduction with heat sources: fins: different types of fins, practical interest of fins, equation of the longitudinal rectangular fin, resolution for the four classical boundary conditions, calculation of lost flux, calculation of fin efficiency and effectiveness, optimal thickness of longitudinal rectangular fins.

Chapter 2. Convective Heat Transfer (5 Weeks)
Mechanisms of convective heat transfer. Parameters involved in convective transfers, highlighting the different types of convective transfer (forced, natural and mixed convection), cite common examples, distinguish between laminar and turbulent convective transfer in both forced and natural modes, methods for solving a convection problem (dimensional analysis and experiments, integral methods for approximate boundary layer equations, solving equations representing convection and analogy with similar phenomena such as mass transfers), citation only.

Chapter 3. Radiation Heat Transfer (3 Weeks)
Introduction: concepts of solid angles, mechanism of surface and volume radiative transfer, definitions and general laws (luminance, illumination, intensity, emittance). Bouguer formula, Kirchhoff's law and Draper's law.

Assessment method:
Exam: 100%.

Bibliographic references:

1. F. Kreith,; RF Boehm et. al. “Heat and Mass Transfer”, Mechanical Engineering Handbook edition Frank Kreith, CRC Press LLC, 1999.
2. Bejan and A. Kraus. “Heat Handbook”, J. Wiley and sons 2003.
3. JF Sacadura coordinator. “Heat transfers: Introduction and further study”, Lavoisier 2015.

4. YA Cengel. “Heat transfer: a practical approach”, McGraw Hill, 2002.
5. YA Cengel. “Heat and Mass Transfer”, McGraw Hill.
6. HD Baehr and K. Stephan. “Heat and Mass transfer”, 2nd revised edition, Springer Verlag editor, 2006.
7. FP Incropera and DP Dewitt.” Fundamentals of Heat and Mass transfer”, 6th edition, Wiley editor.
8. AM. Bianchi , Y. Fautrelle, J. Etay. “Heat transfers”, Polytechnic and University Press Romandes 2004.
9. JP Holman. “Heat Transfer, 6th edition, McGraw Hill publisher, 1986.
10. JH lienhard IV and JH Lienhard V. “Heat Transfer Textbook”, 3rd edition, Phlogiston Press, 2004.
11. C. Long and, N. Sayma. “Heat Transfer”, Ventus Publishing APS, 2009.
12. Hans Dieter Baehr, Karl Stephan. “Heat and Mass Transfer”, Springer editor, 2006.
13. JL. Battaglia, A. Kusiak, JR. Puiggali. “Introduction to heat transfer: course and solutions”, Dunod edition, Paris 2010.

Semester: 5

Teaching unit: UED 3.1

Subject 2: Sensors and Metrology

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

Credits: 1

Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge: Electrical and electronic measurements, Basic electronics.

Content of the material:

Chapter 1. General Information (2 Weeks)

The constituent elements of a measurement chain, the sensors (passive, active), the conditioning circuits (divider, bridges, amplifiers and instrumentation amplifier). Classification of sensors

Chapter 2. Temperature Sensors (2 Weeks)

Platinum probe, thermistor, thermocouple, semiconductor thermometer, optical pyrometer

Chapter 3. Photometric sensors **(2 Weeks)**

Photometric quantities, Photoresistor, photodiode, phototransistor.

Chapter 4. Position sensors **(2 Weeks)**

Resistive, inductive, capacitive, digital, proximity.

Chapter 5. Strain, force and pressure sensors **(2 Weeks)**

Chapter 6. Rotation speed sensors Analog, digital tachometer. **(2 Weeks)**

Chapter 7. Flow, level, humidity sensors **(2 Weeks)**

Chapter 8. Data Acquisition Chain **(1 Week)**

Assessment method:

Review: 100%.

Bibliographic references:

1. Georges Asch and Collaborators, “Sensors in industrial instrumentation”, Dunod, 1998.
2. Ian R. Sintclair, “Sensors and transducers”, NEWNES, 2001.
3. JG Webster, "Measurement, Instrumentation and Sensors Handbook", Taylor & Francis Ltd.
4. M. Grout, "Industrial Instrumentation: Specification and Installation of Sensors and Valves of regulation", Dunod, 2002.
5. R. Palas-Areny, JG Webster, "Sensors and signal conditioning", Wiley and Sons, 1991.
6. R. Sinclair, “Sensors and Transducers”, Newness, Oxford, 2001.

Semester: 5

Teaching unit: UET 3.1

Subject: Environment and sustainable development

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

Credits: 1

Coefficient: 1

Teaching objectives:

Raise awareness of the relationship between energy, the environment and sustainable development and control sources of pollution, reduce them in order to ensure sustainable development.

Recommended prior knowledge: Fluid mechanics,
fundamental thermodynamics, heat transfer, and environmental characteristics.

Content of the material:

Chapter 1. Introduction to the concept of environment (2 weeks)

Definition of the environment, general definition, legal definition, brief history, man and the environment, how man has modified his environment, scapegoat demography.

Chapter 2. The concept of sustainable development (2 weeks)

Definition, brief history, fundamental principles of sustainable development, ethical principle, precautionary principle, prevention principle, sustainable development objectives, environmental issues of sustainable development.

Chapter 3. Environment and Natural Resources (4 Weeks)

Introduction, resources: water, air; fossil fuels (oil, natural gas, coal, etc.), other energies (solar, wind, hydraulic, geothermal, biomass, etc.), mineral elements, biodiversity, soils, food resources.

Chapter 4. Substances (4 Weeks)

The different types of pollutants, regulated pollutants, organic compounds, heavy metals, particles, chlorofluorocarbons, the effects of different substances on the environment, the greenhouse effect and climate change, destruction of the ozone layer, acidification, eutrophication and photochemistry, acid rain. Ozone peaks, effects on materials, effects on ecosystems: forests, freshwater reserves, effects on health, different types of emitters, the Corinair nomenclature.

Chapter 5. Environmental Preservation (3 Weeks)

Introduction of new materials, reserving oil for noble uses, improving energy efficiency, recycling, economic, legal and regulatory mechanisms for environmental preservation, the role of public authorities in solving environmental problems, the possible option of private solutions, current environmental policies, the polluter-pays principle, ecological taxation: ecotaxes, the market for tradable emission permits.

Assessment method:

Review: 100%.

Bibliographic references:

1. De Jouvenel. “The Theme of the Environment: Analysis and Forecasting”, 10, pp. 517533. 1970
2. S. Faucheux, JF Noël. “Economics of natural resources and the environment”, Armand Collin, Paris.
3. D. Reed. “Structural adjustment, environment and sustainable development”, l’Harmattan, Paris, 1995.
4. FD. Vivien. “History of a word, history of an idea: sustainable development standing the test of time”, Elsevier ASA Scientific and Medical Publishing, pp. 19-60, 2001.
5. A. Boutaud, N. Gondran. “The Ecological Footprint”, Paris: La Découverte, p. 128, 2009.
6. Y. Lazzeri. “Sustainable development, businesses and territories: towards a renewal of practices and tools”, L'Harmattan, p. 284, Paris, 2008.

Semester: 6

Teaching unit: UEF 3.2.1

Subject 1: Technology of thermal and hydraulic machines

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

Credits: 4

Coefficient: 2

Teaching objectives:

This program aims to provide the student with the fundamental bases of thermal and hydraulic machine technology.

Recommended prior knowledge: MDF, physics

and maths from L1 and L2.

Content of the material

Chapter 1. Heat Exchangers (2 Weeks)
Types, thermal performance evaluation, DTLM method, NUT method, exchanger technology.

Chapter 2. Design of exchangers Phase **(2 Weeks)**
change exchanger (Condenser – Evaporator).

Chapter 3. Boilers Heat **(2 weeks)**
transfer fluid, characteristics, types of boilers, operation and maintenance.

Chapter 4. Steam Turbine **(2 Weeks)**
Operation, Action Turbines, Reaction Turbines, Centripetal Turbines.

Chapter 5. Turbine sizing: Efficiency, **(2 Weeks)**
consumption, regulation and safety devices.

Chapter 6. Gas turbine **(3 Weeks)**
cycles, turboshaft engines, turbojets.

Chapter 7. Hydraulic turbines Kaplan **(2 Weeks)**
turbine, Pelton turbine, Francis turbine.

Assessment method:

Continuous assessment 40%: Exam 60%.

Bibliographic references:

1. André Lallemand. **“ Hydraulic** and thermal machines: Summaries and corrected problems, level C ”, 2014.
2. M. Sedille. “ Hydraulic and thermal turbomachines, volume IV: Mechanics of compressible fluids ”, 1970.
3. Marcel Sédille. “ Hydraulic and thermal turbomachines (Collection of the National Conservatory of arts and crafts) ”, 1967.
4. A. Boyer-Guillon. “ Testing of thermal and hydraulic machines at the Testing Laboratory of National Conservatory of Arts”, 1910.
5. Michel Portelli. “ Industrial Hydraulics Technology: Courses and Solved Exercises, STS-IUT- Continuing Education ”, Casteilla Editions, 1995.

6. José Roldan Viloria. “Industrial Pneumatics Reference Guide,” 2013.
7. José Roldan Viloria. “ Industrial Hydraulics Pocket Reference Guide ”, 2014.

Semester: 6

Teaching unit: UEF 3.2.1

Subject 2: Dynamics of structures

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

Credits: 4

Coefficient: 2

Content of the material

Chapter 1: Introduction to Structural Dynamics • Objective of Structural Dynamics • Characteristics of a Dynamic Problem • Types of loads • Simple harmonic movements • Excitation of a Vector Representation of Harmonic Motions. **(3 weeks)**

Chapter 2: Forced Vibrations of 1-Degree-of-Freedom Systems (3 weeks)

• structure (Harmonic excitation, Periodic excitation, Dynamic excitation any)
• Response of a conservative structure
• Response of a damped structure

Chapter 3: Vibrations with 2 degrees of freedom • Free vibrations (notion of natural modes) • Time response of an excited system **(3 weeks)**

Chapter 4: Systems with N degrees of freedom • Properties of matrices • Calculation of frequencies and modes • Response to an excitation **(4 weeks)**

Chapter 4: Vibration Measurement • Principle diagram • Seismography • Accelerometry • Calibration **(2 weeks)**

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographic references:

1- R. Glough, J. Penzien. “Dynamics of Structures”, Pluralis edition, 1980.
2- M. Lalanne, P. Berthier, JDHagopian, “Mechanics of linear vibrations” , Masson edition, 1980.
3- SGKelly. Mechanical Vibrations. Theory and applications”, Cengage learning, 2012.
4- Thomas Gmür. “Dynamics of Structures: Numerical Modal Analysis”, Presses Polytechniques et Universitaires Romandes, 1997.
5- “Dynamics of Structures”, National School of Mines of Paris, June 2013.
6- Patrick Paultre. “Dynamics of Structures”, Hermès-Lavoisier editions, 2005.
7- A. Samikian. “Analysis and calculation of structures”, Quebec, 1984.
8- MA Studer and F. Frey. “Introduction to the Analysis of Structures”, Lausanne, 1997.

9- R. Clough and JA Penzien. “Dynamics of Structures,” second edition, Berkeley, 2004.

Semester: 6

Teaching unit: UEF 3.2.2

Subject 1: Signal Processing

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

Credits: 4

Coefficient: 2

Teaching objectives:

To familiarize the student with digital signal processing techniques such as spectral analysis and digital filtering.

Recommended prior knowledge Signal theory,

Mathematics 3, Fundamental electronics 1, Probability and statistics.

Content of the subject:

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

Chapter 1. Reminders of the main results of Signal Theory Signals. **(1 Week)**

Fourier series. Fourier transform and conditions of existence. Parseval's theorem. Plancherel's theorem. Convolution and correlation.

Chapter 2. Random Processes **(4 Weeks)**

Notions on random variables (discrete and continuous, probability density, mathematical expectation, variance, standard deviation, etc.), Characteristics of random processes: mean, autocorrelation functions, inter-correlation, stationarity in the broad and strict sense, ergodism, power spectral density. Particular processes (Gaussian processes, Poisson processes,
Telegraph signal, pseudo-random sequences). Noises (thermal noise, shot noise, etc.)

Chapter 3. Analysis and synthesis of analog filters. **(3 Weeks)**

Reminders on the Laplace transform. Time and frequency analysis of analog filters.
Poles, Zeros, P-Plane and Stability of Analog Filters. Passive and Active Filters, First and Second Order Low-Pass Filters, First and Second Order High-Pass Filters, Band-Pass Filters. Other Analog Filters (Butterworth, Chebyshev I and II, Elliptical, etc.)

Chapter 4. Signal Sampling Sampling: **(3 Weeks)**

Principles and definition (theoretical, averaging, blocking, etc.). Anti-aliasing filter.
Shannon Condition. Analog Signal Restitution and Interpolation Filter. Quantizations, Quantization Noise. Examples of Analog-to-Digital Conversion and Digital-to-Analog Conversion.

Chapter 5. **Discrete Transforms** **(4 Weeks)**

Definition of TFTD (Discrete Time Fourier Transform), TFD (Discrete Fourier Transform), Inverse TFD, Relationship between Fourier Transform and TFD, Weighting Windows, Properties of TFD and Circular Convolution, Fast TFD Algorithms (FFT). Z Transform and Introduction to Digital Filtering (Interest, Time Equations, Transfer Function, Classification, Realization Structures, etc.).

Assessment method:

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

Bibliographic references:

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

Semester: 6

Teaching unit: UEF 3.2.2

Subject 2: Controlled Systems and Regulation

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

Credits: 4

Coefficient: 2

Teaching objectives:

In this course, the student learns basic knowledge on the study and modeling of physical systems and acquires a methodological approach for the design of analog correctors.

Recommended prior knowledge: The student should be familiar with mathematical concepts such as: differential equations, integrals and exponential functions.

Content of the material:

Chapter 1. General Introduction, control, regulation: definitions, open loop control, closed loop control. **(2 Weeks)**

Chapter 2. Laplace Transform Laplace transform, definition, conventions, initial and final values, inverse transformation, relation, differential equation and transfer function, canonical form of any transfer function. **(3 Weeks)**

Chapter 3. Time-domain study of **1st and 2nd order linear systems** Transient response, permanent response, impulse response, step response, response to a ramp (tracking error), response to any input. **(3 Weeks)**

Chapter 4. Frequency or harmonic study of linear systems Harmonic response, definition, theoretical study of the harmonic response, representations of a complex number (Bode, Nyquist, Black), transfer loci of the differentiator, transfer loci of the integrator, first-order transfer loci, second-order transfer loci, Bode loci of any systems, appearance of the Nyquist loci of any systems. **(3 Weeks)**

Chapter 5. Looped Systems General information, closed-loop transfer function, loop stability, stability margins (damping of the looped system), Black chart, precision of servocontrols, velocity of servocontrols, sensitivity to disturbances. **(2 Weeks)**

Chapter 6. Performance Improvement: PI, PD, PID Correctors) Reminders, improvement of Precision (PI corrector), improvement of Precision and Velocity (PD corrector), tachometric correction, PID correction, example of Realization of series and parallel PID correctors. **(2 Weeks)**

Note: It is essential to plan a few practical work sessions on controlled systems depending on the availability of the establishment's resources.

Assessment method:

Continuous assessment: 40% and exam: 60%.

Bibliographic references:

1- Henri Bourles. “Linear systems from modeling to control”, Lavoisier edition 2006, Paris.

2- Jean Marie Flans. “Industrial Regulation”, Hermès edition 1994, Paris.

3- Philippe de Larminat. “Automatic control of linear systems”, Hermès edition 1996, Paris.

4- Patrick Prouvost. “Automation: Control and Regulation”, Dunod edition, 2010.

5- Yves Granjon. “Automatic”, Dunod edition, 2010.

6- Olivier Le Gallo. “Automation of mechanical systems”, Dunod edition, 2009.

7- Gérard Boujat, Patrick Anaya. “Industrial Automation”, Dunod edition, 2007.

8- Janet Maurice. “A Handbook of Matrix Calculus and Operational Calculus”, Euclid Edition, 1982.

9- Patrick Prouvost. “Automation: Control and Regulation”, Dunod edition, 2010.

Semester: 6

Teaching unit: UEF 3.2.2
Subject 3: Reliability

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

Coefficient: 1

Teaching objectives:
To teach the student the concepts of reliability of different production systems, their calculations. Ability to analyze failures and decisions to be made to maintain a system in good condition.

Recommended prior knowledge: Physics and math courses from L1 and L2.

Content of the material:

Chapter 1: Operational Reliability (3 Weeks)
Area of use, equipment behavior, failure rate, characteristics, graphical representation.

Chapter 1: Reliability Assessment Methods **(2 Weeks)**

Chapter 3: System Reliability - Predictive Reliability **(3 Weeks)**

Chapter 4: System Maintainability **(3 Weeks)**

Chapter 5: System Availability **(2 Weeks)**

Chapter 6: Operational Safety **(2 Weeks)**

Assessment method:
Exam: 100%.

Bibliographic references:

1. Patrick Lyonnet and Marc Thomas. “Reliability, diagnosis and predictive maintenance of systems”, 2012.
2. “Diagnostic reliability and predictive maintenance of technical and human reliability systems”, Tec&Doc, 2012.
3. Jean-Claude Morin , Sylvie Gaudeau 1”, ， Hassan Houraji. “Maintenance of industrial equipment, Volume Bac Pro - Student book – Ed, 2011.
4. Jean-Claude Morin and Sylvie Gaudeau. “Maintenance of industrial equipment”, Bac Pro - Book Professor – Ed, 2011.
5. Aziz Bekri and Ludovic. PigeyreTop'Fiches Bac Pro, “Maintenance of Industrial Equipment”, 2009.
1. JS David. Reliability, “maintenance and risk, l’Usine Nouvelle ”, Dunod edition , 2006.

Semester: 6

Teaching unit: UEM 3.2.

Subject 1: End of Cycle Project

VHS: 45h00 (TP: 3h00)

Credits: 4

Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge: The entire Bachelor's program.

Content of the subject:

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

Noticed :

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

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

- The detailed presentation of the study theme, emphasizing its interest in its socio-economic environment.
- The means implemented: methodological tools, bibliographic references, contacts with professionals, etc.
- Analysis of the results obtained and their comparison with the initial objectives.
- Criticism of the observed deviations and possible presentation of other additional details.
- Identification of the difficulties encountered by highlighting the limits of the work carried out and the follow-up to the work carried out.

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

Assessment method:

Continuous assessment: 100%

Semester: 6

Teaching unit: UEM 3.2.

Subject 2: Internal combustion engine

VHS: 37h30 (Lecture: 1h30, Tutorial: 1h00)

Credits: 3

Coefficient: 2

Teaching objectives:

Understand how different types of internal combustion engines work, both thermodynamically and mechanically.

Recommended prior knowledge:

Thermodynamics, physics1, mathematics

Content of the material:

Chapter 1. General Information (3 Weeks)

Principle of operation and classification of thermal engines, fuels of internal combustion engines.

Chapter 2. Thermodynamics of engine cycles (4 weeks)

Beau de Rochas cycle, Diesel cycle, Sabathé cycle, real cycles and efficiencies, energy balance, fuel supply for gasoline engines, ignition system for gasoline engines, combustion.

Chapter 3. Real cycle of a diesel internal combustion engine (3 Weeks)

Admission, compression, combustion, expansion, exhaust, indicated parameters, effective parameters, construction of the theoretical indicated diagram.

Chapter 4. Dynamics of Reciprocating Engines (3 Weeks)

Crank rod system (kinematic study, dynamic study), distribution system (kinematic study, dynamic study), balancing.

Chapter 5. Performance and Characteristics of Reciprocating Engines (2 Weeks)

Performance parameters, standards, characteristics (Full load, partial loads, universal).

Assessment method:

Continuous assessment: 40%, Exam: 60%.

Bibliographic references:

1. JB Heywood. “Internal Combustion Fundamentals”, McGraw Hill Higher Education, 1989.
2. P. Arquès. “Design and construction of reciprocating engines”, Ellipse edition, 2000.
3. JC. Guibet. “Fuels and Engines,” 1997.
4. P. Arquès. “Reciprocating Internal Combustion Engines (Technology)”, Masson edition 5. UY , 1987.
Famin, AI Gorban, VV Dobrovolsky, AI Lukin et al. “Marine Internal Combustion Engines”.
Leningrad: Sudostrojenij, 1989.
6. M. Menardon. “The Internal Combustion Engine,” Deboeck Editions, 1998, Paris.
7. D. Jolivet. “The diesel engine”, Ellipses edition, 1986, Paris.
8. A. Benabbassi. “Internal combustion engines: Introduction to the theory”, Algiers, OPU. 2002.

Semester: 6

Teaching unit: UEM 3.2.

Subject 3: Repairs and interventions/Internal Combustion Engine (ICE) practical work

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

Credits: 2

Coefficient: 1

Part 1: TP Repairs and interventions

Teaching objectives:

This program aims to provide students with the tools to diagnose and prepare interventions for the maintenance of industrial machines and installations.

Recommended prior knowledge:

Machine elements, Physics materials and RDM

Content of the material:

TP1- Study of elements for detecting anomalies Wear and lubrication, corrosion.

TP2- Breakage and cracks of parts
Overload failure, fatigue failure, fatigue stress factor.

TP3- Disassembly and reassembly of machines

TP4- Parts control (including non-destructive testing)

TP5- Restoration of defective parts
Geometric shapes, reloading and machining, metallization.

TP6- Repair and intervention techniques

Part 2: Internal Combustion Engine Practical Work

Practical work : Plan some experiments related to internal combustion engines depending on the availability of resources.

Assessment method:

Continuous assessment: 100%.

Bibliographic references:

1. "MERSI: Memento of the environment, risks, security, and intervention of the Ministry of the Environment", France, 1994.
2. Jean-Paul Souris. "The Perfect Maintenance Manager's Guide," 2010.
3. L. Pigeyre and P. Ponson. "Maintenance of Industrial Equipment" , BEP Bac Pro, 2006.
4. Pascal Denis and Pierre Boyé. "Guide to Industrial Maintenance," 2008.
5. François Castellazzi and Yves Gangloff. " Industrial Maintenance: Equipment Maintenance industrialists", 2006.
6. Ludovic Pigeyre and Pascal Ponson. " Objective Bac Pro Bac Pro Mei Sheets: Equipment Maintenance industrialists", 2015.
7. Jean-Marie Auberville. "Industrial Maintenance: From Basic Maintenance to Safety Optimization ", 2004.
8. Alain Reiller. " Analysis and maintenance of industrial automation: Industrial engineering ", 1999.
9. François Monchy and Jean-Pierre Vernier. " Maintenance: Methods and organizations for better productivity", 3rd edition, Dunod, 2012.

Semester: 6

Teaching unit: UED 3.2.

Subject: Conditional preventive maintenance tools VHS: 10:30 p.m.

(Course: 1:30 p.m.)

Credits: 1

Coefficient: 1

Teaching objectives:

To teach the student the objectives of Preventive Maintenance such as: increasing the lifespan of equipment, reducing the probability of failures in service, reducing downtime in the event of overhaul or breakdown, how to avoid abnormal consumption of energy and lubricant, improving the working conditions of production personnel, reducing the maintenance budget, eliminating the causes of serious accidents, etc.

Recommended prior knowledge: S5 subjects.

Content of the subject:

Chapter 1. Types of Preventive Maintenance (2 Weeks)

Systematic maintenance, conditional maintenance, predictive maintenance.

Chapter 2. Implementing Preventive Maintenance (4 Weeks)

Definition of the systematic, conditional and predictive preventive maintenance plan, definition and integration of monitoring means, planning and implementation of the preventive maintenance plan, use of the information collected, updating and optimization of the preventive maintenance plan.

Chapter 3. The different levels of maintenance. (9 Weeks)

Simple adjustments that do not require disassembly or opening of the equipment, e.g. Troubleshooting by standard exchange of the elements provided for this purpose and minor preventive maintenance operations, e.g. Identification and diagnosis of faults, e.g. All major corrective or preventive maintenance work except renovation and reconstruction, e.g. All renovation, reconstruction or major repair work entrusted to a central maintenance workshop or a service provider company, e.g.

Assessment method:

Exam: 100%.

Bibliographic references:

1. Jean Heng. “Preventive Maintenance Practice - 3rd Edition: Mechanics. Pneumatics. Hydraulics. Electricity. Cold, 2011.
2. Who, World Health Organization, Unaids. “ Manual of Management, Maintenance and Use: of the equipment of the cold chain for blood”, 2008.
3. François Monchy, Jean-Pierre Vernier. "Maintenance. Methods and Organizations for Better Productivity. Collection: Technology and Engineering ," Dunod/L'Usine Nouvelle, 3rd edition, 2012.

Semester: 6

Teaching unit: UED 3.2

Subject: Industrial Robotics VHS:

10:30 p.m. (Course: 1.5 hours)

Credits: 1

Coefficient: 1

Teaching objectives:

Discovery of the field of industrial robotics by describing the characteristics of robots and the automatic methods of calculating their direct and inverse geometric models as well as the actuators and sensors used.

Recommended prior knowledge: Mathematics : linear algebra: matrix calculus, Computer science.

Content of the material:

Chapter 1. Description of robots (3 weeks)

Introduction, definition of a robot, components of a robot, different kinematic chains, joint coordinates, dof of a robot, operational coordinates, programming modes, characteristics of a robot, applications of robotics.

Chapter 2. Homogeneous Transformation Matrices (3 Weeks)

Introduction, representation of a point, vector, plane, reference frame; homogeneous transformation matrices (pure translation, pure rotation and combined transformation), inverse of homogeneous transformation.

Chapter 3. Direct Geometric Model of a Robot (3 Week)

Introduction, Dénavit-Hartenberg parameterization, intermediate transformation matrices, MGD, workspace simulations.

Chapter 4. Inverse Geometric Model of a robot Introduction, Paul method, MGI trajectory tracking. , **(3 Weeks)**

Chapter 5. Actuators and sensors used in robotics (3 weeks)

Introduction, robot actuators, robot proprioceptive sensors, robot proprioceptive sensors.

Assessment method:

Exam: 100%.

Bibliographic references:

1. Saeed B Niku 2. , Prentice Hall. “Introduction to robotics: Analysis, systems, Applications”, NJ, 2001.
Wissama Khalil and Etienne Dombre. “Modeling, Identification and Control of Robots”, HERMESS Science Publications, Paris, 1988, 1999.
3. Pierre Gaucher 4. , Arnaud Puret, Nicolas Monmarché. “Robotics workshop”, 2010.
F Cochet , JH Jacot, Yves Bouchut. “Industrial robotics and investment choices”, 1996.
5. Philippe Coiffet , Michel Chirouze. “Elements of Robotics,” 1982.

Semester: 6

Teaching unit: UET 3.2.

Subject: Professional project and business management

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

Credits: 1

Coefficient: 1

Teaching objectives:

Prepare and master the methodological tools necessary for professional integration at the end of studies, prepare for the job search. Be made aware of entrepreneurship by presenting an overview of management knowledge useful for the creation of activities and be able to implement a project.

Content of the subject:

Chapter 1: Business and Society **(3 weeks)**

The Company: Definition and objectives of the company. Different forms of business, company structure, personnel and partners of the company.

Different types of business (VSE, SME, SMI, ETI, GE)

The company: Definition and objectives of the company

Different types of business (SARL, EURL, SPA, SNC,)

Difference between business and corporation.

Chapter 2: Operation and organization of the company Method of organization **(2 weeks)**

and operation of the company

The main functions of the company (production company, service company, etc.)

Company structure (definition and characteristics)

Different types of structures (functional, divisional, multidivisional, hierarchical-functional “staff and line”). ,

Additional activities of the company (partnership, subcontracting, etc.).

Chapter 3: How to get into a business **(3 weeks)**

Personnel needs and quality (senior executives, managers, technicians, workers, etc.)

Where can I find the job offer? (ANEM, section, internet, etc.)

How to go about it? (the application, the CV)

The different types of job interviews and how to approach one.

Types of employment contracts (permanent and fixed-term contracts)

Salary (how a pay slip is calculated).

Chapter 4: How to start your own business (3 weeks)

The business creator's journey (the idea, the capital, financial aid, etc.)

How to find a good idea?

Financial aid schemes for investment (ANSEJ, CNAC, ANDI, ANGEM, PNR)

Chapter 5: Study of a business creation project **(4 weeks)**

Studying a business creation project requires the promoter to make the effort to plan and write down in detail the phases and steps that he will have to take to get his business off the ground.

Market research (sales department, marketing, etc.).

Technical study (location, equipment and machinery requirements, production capacity, etc.).
Financial study (turnover, salary costs, expenses and consumption, taxes, etc.).

Mini project for the study of a business creation project.

Assessment method:
100% exam

Bibliographic references:

1. -Antoine Melo "Business Management" Melo France 2016 edition
2. -Thomas Durand Business Management" Paperback Edition 2016
3. -Philippe Guillermic 4. Business Management Step by Step Pocket Edition 2015
-Guy Raimbault "Management tools" Chihab Algiers edition 1994
5. -Institute of Financial Technology 6. Accounting initiation "OPU Algiers 1993
-Christian Bultez "Guide and instructions for the procedures Nathan Paris edition 1993

IV- Agreements / Conventions

STANDARD LETTER OF INTENT

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

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

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

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

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

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

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

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

STANDARD LETTER OF INTENT

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

(Official company letterhead)

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

Provided to:

The company hereby provides declares his will to demonstrate his support for this training as a potential user of the product.

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

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

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

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

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

OFFICIAL STAMP or COMPANY SEAL

V - Opinions and Visas of the Administrative and Consultative Bodies

License title: Industrial maintenance

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

VI – Notice and Visa of the Regional Conference

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