الجمهورية الجزائرية الديمقراطية الشعبية
People's Democratic Republic of Algeria
وزارة التعليم العالي والبحث العلمي
Ministry of Higher Education and Scientific Research

University

Logo

OFFER
LMD

ACADEMIC LICENSE

NATIONAL PROGRAM
2021 – 2022
(2nd update)

Establishment	Faculty / Institute	Department

Domain	Sector	Speciality
Science And Technologies	***Electrotechnics***	***Electrotechnics***

CPNDST

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اللجنة البيداغوجية الوطنية
لميدان العلوم و التكنولوجيا
National Educational Committee for the Field of Science and Technology

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ل. م. د

ليسانس أكاديمية

برنامج وطني
2022- 2021

المؤسسة	الكلية/ المعهد	القسم

الميدان	الفرع	التخصص

كهروتقني	كهروتقني	علوم و تكنولوجيا

Summary

VI- Opinion and Visa of the Regional Conference	
VII- Opinion and Visa of the National Pedagogical Committee of the Domain (CPND)	

I–License identity sheet

1 - Location of the training:

Faculty (or Institute):

Department :

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

2-External partners:

Other partner establishments:

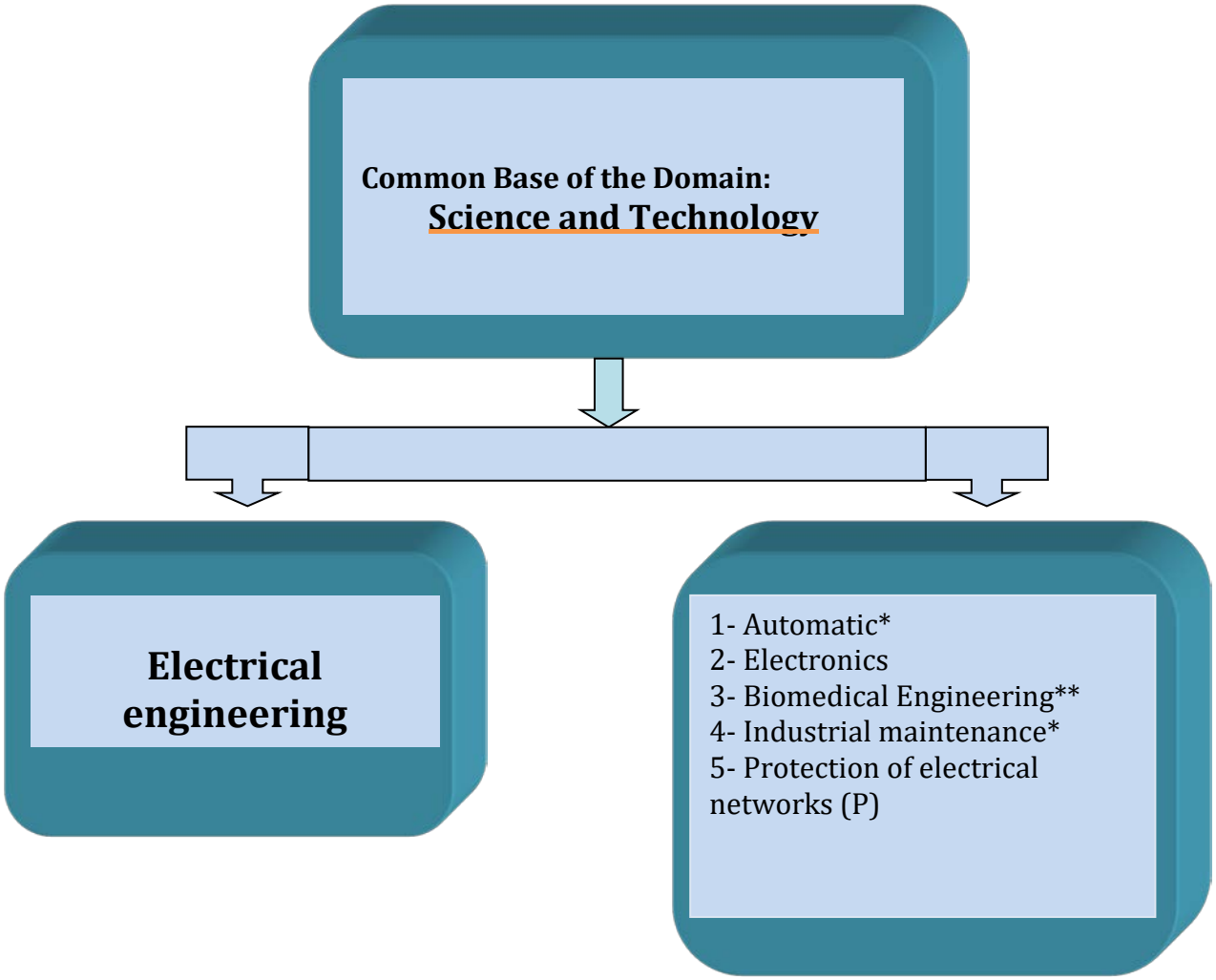
Businesses and other socio-economic partners:

International partners:

3–Context and objectives of the training

A – General organization of training: project position

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



B - Training objectives:

Electric energy is at the heart of the economic development of any country. It is inevitably vitalfor the functioning of all the mechanisms that govern the different social dynamics. As such, electrical engineering, in all its segments (production, transportation, distribution, conversion and control) has occupied a primordial place in the industrial sector of the countries and continues tobe the subject of special attention, scientific investment and continuous technological improvement.
LElectrical engineering continues to develop thanks to advances in power electronics, microprocessors and programmable logic controllers.
In addition, the optimization of electrotechnical systems and the improvement of their efficiency constitutes a promising issue for the sector thanks to the application of sustainable development concepts by reducing their weight and using recyclable materials.
All these major technological developments recorded in recent years have increased the needs of industrial companies for skills in the field of electrical engineering. Investing in training and preparing executives to meet these challenges becomes essential.It is with this objective that this training is offered.

The training is structured in 6 semesters, the first two of which (Common Base) concern all students in the field.Science and Technology. The thirdsemester constitutes a pre-specialization and brings together all students from the Electrical Engineering family. From semester 4, the lessons become specialized and are mainly oriented towards electrical engineering.

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

C – Targeted profiles and skills:

The main objective of this training is to enable students to acquire a dual qualifying diploma. So,the holders of this License will have acquired,at the end of this course,the skills necessary to enter a professional environment inthe production, transport, distribution or exploitation of electrical energy. They can also, through the theoretical lessons acquired, continue their studies in one of the many existing Masters.

Thus, the Electrotechnical License gives the student good adaptation skills capable of allowing them to assert themselves in the face of new situations during their career. In this regard, it is able to:

- ✓ Understand the physical phenomena linked to the transformations and use of electrical energy.
- ✓ Define and operate electrical power equipment and associated control systems to produce energy or operate automation systems.
- ✓ Know the different components of electrical networks and become familiar with the means of control and protection.

- ✓ define distribution, protection and control equipment, from high voltage to low voltage and their commissioning.
- ✓ Understand the real specificities of electrical networks and the means to implement for the stability of these networks.
- ✓ Adapt to new technological specificities of businesses.

D – Regional and national employability potential:

All industries today operate on electrical energy and use electrical machines. It is therefore clear that theThe employability opportunities for holders of this License throughout the national territory areguaranteed, this on the one hand. Moreover,Andtaking into account national guidelines for the development of strategic sectors (seawater desalination, electricity production and renewable energies),private and/or public investors will certainly begin to exploit, in the near future, modern means of electricity production, which therefore portends a promising future for graduates of this sector.

Generally speaking, the energy sector still remains promising in terms of opportunities in different areas: the oil and gas industries, refrigeration, air conditioning, agri-food, transport, chemical industries, hydraulics, heavy industries, etc.

E – Gateways to other specialties:

Common semesters 1 and 2	
Sector	**Specialties**
Aeronautics	Aeronautics
Civil engineering	Civil engineering
Climate engineering	Climate engineering
Maritime genius	Naval Propulsion and Hydrodynamics
	Naval construction and architecture
Mechanical Engineering	Energy
	Mechanical construction
	Materials Engineering
Hydraulic	Hydraulic
Transportation Engineering	Transportation Engineering
Metallurgy	Metallurgy
Precision optics and mechanics	Optics and photonics
	Precision engineering
Public works	Public works
Automatic	Automatic
Electromechanics	Electromechanics
	Industrial maintenance
Electronic	Electronic
Electrical engineering	Electrical engineering
Biomedical genius	Biomedical genius
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

Group of sectors A Common semester 3	
Sector	**Specialties**
Automatic	Automatic
Electromechanics	Electromechanics
	Industrial maintenance
Electronic	Electronic
Electrical engineering	Electrical engineering
Biomedical genius	Biomedical genius
Industrial Engineering	Industrial Engineering
Telecommunication	Telecommunication

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

Group of sectors C Semester 3 common	
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 sectors which present basic lessons common to each other (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 Engineering Processes and Mining Engineering (Group C).

This degree offers multidisciplinary and transversal teaching programs:

Multidisciplinary, in the sense that the lessons 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 lessons of semester 3 for all the specialties in the same group of sectors are also 100% identical.

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

In a transversal way, this License offers the student the choice of joining, if they express the desire and depending on the educational places available:

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

- All specialties from the same group of sectors tothe end of semester 3.

- All specialties from another group of sectors tothe end of semester 3
(Subject to equivalence and advice from the training team).

- All specialties from the same group of sectors tothe end of semester 4
(Subject to equivalence and advice from the training team).

F – Performance indicators expected from the training:

All training must meet the quality requirements of today and tomorrow. As such,pto better appreciate theexpected training performanceproposedon the one hand anden exploiting the flexibility and flexibility of the LMD system on the other hand,it is proposed, for information only, for this license a certain number of mechanisms to evaluate and monitor the progress of teaching, training programs, student/teacher and student/administration relationships, the future of graduates of this license 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 as well as their employers. For this, a report must be established,archiveand widely distributed.

1. Evaluation of the course of the training:

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

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

Before the training:

- ✓ Evolution of the rate of students having chosen this License (Rsupply/demand contribution).
- ✓ Rateand quality of studentswho choose this license.

During training:

- ✓ Regularity of meetings of educational committees.
- ✓ Compliance of the themes of the End of Cycle Projects with the nature of the training.
- ✓ Quality of the relationship between students and the administration.
- ✓ Support provided to students in difficulty.
- ✓ Student satisfaction rate with lessons and teaching methods.

After the training:

- ✓ Student success rate per semester in this Degree.
- ✓ Ratewastage (failure and abandonment) of students.
- ✓ Identification of the causes of student failure.
- ✓ Reorientation alternatives are offered to students in a situation of failure.
- ✓ Ratestudents who graduate on time.
- ✓ Ratestudentswho continue their studies after the license.

2. Evaluation of the course of lessons:

The lessons in this course are 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 responsible for teaching, Faculty, etc.

As a result, a system for evaluating programs and teaching methods can be put in place based on the following indicators:

- ✓ Equipping teaching rooms and laboratories with materials and supports necessary for educational improvement (projection systems (data shows), wifi connection, etc.).
- ✓ Existence of a communication and teaching platform in which courses, tutorials and practical work are accessible to students and their questions resolved.
- ✓ Equipping educational laboratories with materials and equipment in line with the teaching content.
- ✓ Number of effective teaching weeks provided during a semester.
- ✓ Completion rate of teaching programs.

- ✓ Digitization and conservation of end of studies and/or end of cycle dissertations.
- ✓ Number of TPs carried out as well as the multiplication of the type of TPs per subject (diversity of TPs).
- ✓ Quality of the establishment's documentary collection in relation to the specialty and its accessibility.
- ✓ Support from the socio-economic sector for training (company visit, company internship, seminar courses provided by professionals, etc.).

3. Integration of graduates:

A coordination committee is created, made up of those responsible for training and members of the Administration, which is mainly responsible for monitoring the integration of graduates from the sector into professional life, and for establishing a graduate monitoring file. of the sector, to identify and/or update the existing economic and industrial potential at the regional and national level, to anticipate and encourage new professions in relation to the sector in association with the chamber of commerce, the various support agencies employment, public and private operators, etc., to participate in any action concerning the professional integration of graduates (organization of events with socio-economic operators).
To carry out these missions, this committee has complete freedom to carry out or commission any study or survey on the employment and post-employment of graduates. Below is a list ofindicators and modalities that could be considered to evaluate and monitor this operation:

- ✓ Recruitment rate of graduates in the socio-economic sector in a position directly related to training.
- ✓ Nature of jobs held by graduates.
- ✓ Diversity of outlets.
- ✓ Establishment of an association of former graduates of the sector.
- ✓ Creation of small businesses by graduates of the specialty.
- ✓ Level of employer satisfaction.

G- Evaluation of the student through continuous assessment and personal work:

G1- Evaluation by continuous monitoring:
The importance of continuous assessment methods on the training of students in terms of educational achievements no longer needs to be demonstrated. In this regard,Articles 20, 21 and 22 of Order 712 of November 3, 2011, define and specify the terms and organization of the continuous evaluation of students according to the training course. The calculation of the averages for continuous assessment (tutorials and practical work) is made from a weighting of all the elements which constitute this evaluation. These articles specify that this weighting is left to the discretion of the teaching team.

A survey carried out by the CPND-ST among all teachers in the different university establishments showed heterogeneity in the implementation of continuous assessment of students. Also, we are led toadmit a real deficit in the effective management of this educational activity which required serious reflection on this subject on our part which, combined with the proposals coming from several establishments, resulted in the recommendations below.

The analysis of the different proposals coming from these establishments showed that, indeed, articles 21 and 22 of decree 712 of November 3, 2011 are not explicit enough and

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

1. Proposals relating to subjects with guided work:

1.1. Preparing the series of exercises:

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 in a tutorial session.
These exercises must be prepared by the student before coming to tutorial. This preparation can be evaluated. The evaluation method is left to the discretion of the teacher responsible for the tutorial.
The exercises not solved in tutorial can be the subject of personal work to be carried out by groups of 3 to 4 students and to be submitted for evaluation (deadline: 1 week).

1.2. Written questions:

Each end of a series of exercises (ie each end of a chapter) will be followed by a short written quiz. This questioning must be organized in collaboration with the subject manager in order to ensure a fair evaluation for all students (essentially when several teachers are involved in the tutorials).

1.3. Student participation in tutorials:

This participation must be evaluated. The evaluation method is left to the discretion of the teacher responsible for the tutorial.

1.4. Student Attendance:

Student attendance is mandatory in TD and TP. In class, it is difficult to control it for undergraduate students where the numbers are very large (lectures in an amphitheater). For masters where numbers are small, attendance must be compulsory in classes and tutorials.

2. Case of methodological units (Practical work):

In the same way as the tutorials, the practical work must be prepared by the student. A control test of this preparation must be organized by the teacher before each manipulation (in the form of short comprehension questions, multiple choice questions, manipulation diagram, etc.). A report (per working group) must be given at the end of the practical work session. As such, the teacher must prepare a standard report (outline) to facilitate the students' work 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 the manipulations carried out by the student.

3. About cross-curricular subjects and discoveries that do not have a TD or TP:

It is very difficult to carry out continuous assessments in these subjects due to the absence of tutorial sessions and due to the very large number of students in most cases and in particular for very large universities. flow.

However, the teacher in charge of this subject can, if he wishes, let the students know that he can possibly evaluate them (ongoing) by offering them to prepare presentations, to make reports, to look for additional information. of the course, use free software, ask 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 indicated to them the internet link to this film) and ask them to then submit a written report or make an oral presentation of the summary of this film, etc. The improvement of these activities is left to the discretion of the teacher and the

training team whoare the only ones capable of defining the best way to take this personal work into account inthe overall score of the final exam.

In the same vein, 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 person responsible for the subject may consider continuous evaluations of the student like 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 Teaching Council.

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

4. Harmonization of continuous monitoring:

The use of a common grid for evaluation would promote the harmonization of these practices from one teacher to another, from one department to another and from one establishment to another. It would also constitute a structuring and reassuring benchmark for students. To do this, we propose below an evaluation grid for information purposes which presents the various continuous controls making it possible to evaluate the degree of acquisition of students' skills, whether in terms of knowledge or analytical skills. and synthesis skills.

Please note that these assessments are not intended to “trap” students by imposing very difficult continuous assessments on them. On the contrary, it is a question of 'honestly' evaluating the degree of assimilation of the different skills and knowledge taught to the student in complete objectivity. In the same spirit, we would benefit from promoting the contractualization of learning evaluation by specifying, for example, the success criteria and good practices which would result in correct and precise answers to the questions. Thus, the evaluation would mainly focus on the acquired knowledge which was the subject of training by giving exercises linked to what was prepared in tutorial without forgetting, however, to evaluate the students' ability to mobilize their skills in more complex situations.

4-1 Directed work:

Preparation of series of exercises and personal work (homework, presentations, etc.)	30%	06 points
Written questions (minimum 02 questions including one proposed by the subject manager)	50%	10 points
Student participation in tutorials	20%	04 points
Total	**100%**	**20 points**

4.2 Practical work:

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

student.		
Total	**100%**	**20 points**

G2-Student's personal work:

The student's personal work is part of the spirit of the LMD. A very substantial amount of weekly time has been reserved for him: approximately 50% of the total hourly volume of the training (see the table ''Overall training summary'' present in this training offer).

A survey carried out by the CPND-ST among training teams across all university establishments indicated that the time relating to the student's personal work could be judiciously exploited, under good supervision of the teacher, in a manner rational and in different forms. The tasks that would then be accomplished by the 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 free will of the teaching teams.

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

1. Homework:

In order to enrich the knowledge and strengthen the training of students, they will be asked to carry out additional work at home 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, resolve a difficult exercise, go over the proof of a theorem in detail, search for the complement of a course, use free software or a CAD-CAD tool to make applications and simulations linked to the course, etc. These activities can be evaluated, noted and registered as a bonus for the students who carry them out.

2. Mini course project:

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

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 for 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 monitoring score.

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 likely to enable them to better understand the reality of the world of work and subsequently help them achieve better professional integration.

Administrative managers as well as 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. We can offer students templates to help them present their internship report properly.

4. Participation in scientific events:

In order to imbue students with a scientific spirit (mainly for higher level students), they must be guided and encouraged to participate in round tables, laboratory seminars and conferences organized within their faculty and/or establishment. It is even advisable to encourage these students to attend conferences, related to their specialty, outside their university during exhibitions, fairs and others. This activity can be evaluated, graded and recorded as a bonus for the student who completes it.

5. Use of New Information and Communication Technologies:

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

Conclusion :

Student autonomy, considered as a lever for success, relies largely on the personal work that he is required to do, by appropriating the resources and tools made available to him. All this must, of course, be supervised and formalized within the framework of educational monitoring and support which must be provided jointly by the university teacher and the administrative manager throughout the training course.

This autonomy will allow them to build their professional identity according to their aspirations, their abilities and their acquired knowledge or to build their academic career in the pursuit of higher studies.

4 - Human resources available:

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

Number of students:

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

First and last name	Graduation diploma	Specialty diploma (Magister, doctorate)	Grade	Subjects to teach	Registration

Department 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	Home establishment	Graduation diploma	Specialty diploma (Magister, doctorate)	Grade	Subjects to teach	Registration

Department visa

Faculty or institute visa

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

Grade	Internal Workforce	External Workforce	Total
Teachers			
Lecturers (A)			
Lecturers (B)			
Assistant Master (A)			
Assistant Master (B)			
Other (*)			
Total			

(*) Technical and support staff

5 - Material resources specific to the specialty

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

Laboratory title:

Student capacity:

No.	Equipment designation	Number	Comments

B- Internship sites and in-company training:(see agreements/conventions section)

Training place	Number of students	Training period

C- Documentation available at the establishment level specific to the proposed training (mandatory field):

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

II – Half-yearly teaching organization sheets of the specialty

Semester 1

Teaching unit	Modules	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 1.1 Credits: 18 Coefficients: 9	Mathematics 1	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Physics 1	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Structure of matter	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
Methodological EU Code: UEM 1.1 Credits: 9 Coefficients: 5	TP Physics 1	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Chemistry 1	2	1			1h30	10:30 p.m.	27:30	100%	
	Computer science 1	4	2	1h30		1h30	45:00	55:00	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.	02:30		100%
E Transverse Code: UET 1.1 Credits: 2 Coefficients: 2	Ethical and deontological dimension (the foundations)	1	1	1h30			10:30 p.m.	02:30		100%

	Foreign language 1 (French or English)	1	1	1h30			10:30 p.m.	02:30		100%
Total semester 1		**30**	**17**	**4:00 p.m.**	**4:30 a.m.**	**4:30 a.m.**	**375h00**	**375h00**		

Semester 2

Teaching unit	Modules	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 1.2 Credits: 18 Coefficients: 9	Mathematics 2	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Physics 2	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Thermodynamics	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
Methodological EU Code: UEM 1.2 Credits: 9 Coefficients: 5	TP Physics 2	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Chemistry 2	2	1			1h30	10:30 p.m.	27:30	100%	
	Computer science 2	4	2	1h30		1h30	45:00	55:00	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.	02:30		100%
Transversal EU Code: UET 1.2 Credits: 2 Coefficients: 2	Foreign language 2 (French and/or English)	2	2	3:00 a.m.			45:00	05:00		100%
Total semester 2		**30**	**17**	**4:00 p.m.**	**4:30 a.m.**	**4:30 a.m.**	**375h00**	**375h00**		

Semester 3

Teaching unit	Modules	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 2.1.1 Credits: 10 Coefficients: 5	Mathematics 3	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Waves and vibrations	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Fundamental Electronics 1	4	2	1h30	1h30		45:00	55:00	40%	60%
	Fundamental electrical engineering 1	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 2.1 Credits: 9 Coefficients: 5	Probability and statistics	4	2	1h30	1h30		45:00	55:00	40%	60%
	Computer science 3	2	1			1h30	10:30 p.m.	27:30	100%	
	Electronics and electrical engineering TP	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Waves and vibrations	1	1			1h00	3:00 p.m.	10:00 a.m.	100%	
EU Discovery Code: UED 2.1 Credits: 2 Coefficients: 2	State of the art of electrical engineering	1	1	1h30			10:30 p.m.	02:30		100%
	Energy and environment	1	1	1h30			10:30 p.m.	02:30		100%
Transversal EU Code: UET 2.1 Credits: 1 Coefficients: 1	Technical English	1	1	1h30			10:30 p.m.	02:30		100%

Total semester 3		**30**	**17**	**1:30 p.m.**	**7:30 a.m.**	**4:00 a.m.**	**375h00**	**375h00**		

Semester 4

Teaching unit	Modules	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 2.2.1 Credits: 10 Coefficients: 5	Fundamental electrical engineering 2	6	3	3:00.	1h30		67h30	82h30	40%	60%
	Combinatorial logic and sequential	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 2.2.2 Credits: 8 Coefficients: 4	Numerical methods	4	2	1h30	1h30		45:00	55:00	40%	60%
	Signal theory	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 2.2 Credits: 9 Coefficients: 5	Electrical measurements and electronic	3	2	1h30		1h00	37:30	37:30	40%	60%
	Basic electrical engineering TP 2	2	1			1h30	10:30	27:30	100%	
	Combinatorial logic TP and sequential	2	1			1h30	10:30	27:30	100%	
	TP Numerical methods	2	1			1h30	10:30	27:30	100%	
EU Discovery Code: UED 2.2 Credits: 2 Coefficients: 2	Production of electrical energy	1	1	1h30			10:30	02:30		100%
	Electrical safety	1	1	1h30			10:30	02:30		100%
Transversal EU Code: UET 2.2	Expression, information and communication	1	1	1h30			10:30	02:30		100%

Credits: 1 Coefficients: 1	techniques									
Total semester 4		**30**	**17**	**1:30**	**6:00**	**5:30**	**375h00**	**375h00**		

Semester 5

Teaching unit	Modules	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 3.1.1 Credits: 10 Coefficients: 5	Electrical Networks	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Power Electronics	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 3.1.2 Credits: 8 Coefficients: 4	Servo Systems	4	2	1h30	1h30		45:00	55:00	40%	60%
	Electromagnetic Field Theory	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 3.1 Credits: 9 Coefficients: 5	Diagrams and electrical equipment	3	2	1h30		1h00	37:30	37:30	40%	60%
	TP Electrical Networks	2	1			1h30	10:30 p.m.	27:30	100%	
	Power Electronics TP	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Controlled systems/ TP sensors	2	1			1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 3.1 Credits: 2 Coefficients: 2	Sensors and Metrology	1	1	1h30			10:30 p.m.	02:30		100%
	Design of electrical systems	1	1	1h30			10:30 p.m.	02:30		100%
Transversal EU Code: UET 3.1 Credits: 1 Coefficients: 1	Simulation software	1	1	1h30			10:30 p.m.	02:30		100%
Total semester 5		**30**	**17**	**1:30 p.m.**	**6:00 a.m.**	**5:30 a.m.**	**375h00**	**375h00**		

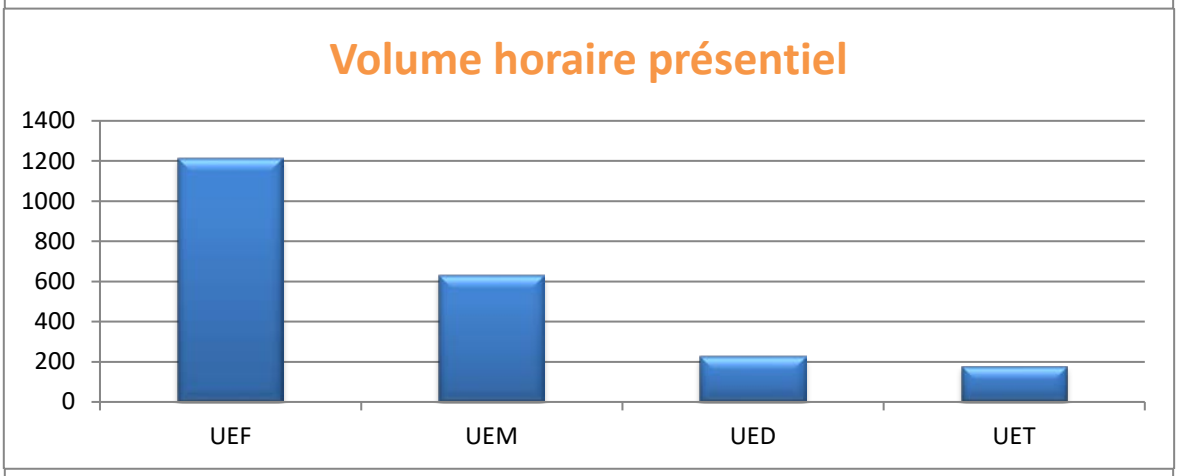
Semester 6

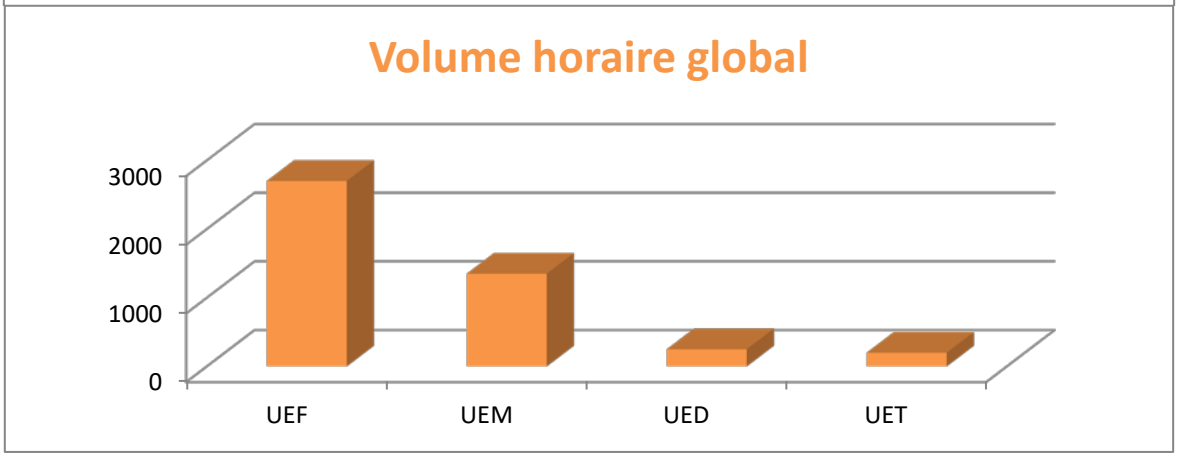
Teaching unit	Modules	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 3.2.1 Credits: 10 Coefficients: 5	electric Machine control	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Industrial regulation	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 3.2.2 Credits: 8 Coefficients: 4	Industrial Automation	4	2	1h30	1h30		45:00	55:00	40%	60%
	Materials and introduction to High Voltage	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 3.2 Credits: 9 Coefficients: 5	End of Cycle Project	4	2			3:00 a.m.	45:00	55:00	100%	
	TP Machine control	1	1			1h00	3:00 p.m.	10:00 a.m.	100%	
	Industrial Regulation TP	2	1			1h30	10:30 p.m.	27:30	100%	
	Automation TP/ Materials and HT TP	2	1			1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 3.2 Credits: 2 Coefficients: 2	Protection of electrical networks	1	1	1h30			10:30 p.m.	02:30		100%
	Industrial maintenance	1	1	1h30			10:30 p.m.	02:30		100%
Transversal EU Code: UET 3.2	Entrepreneurship and business management	1	1	1h30			10:30 p.m.	02:30		100%

Credits: 1 Coefficients: 1										
Total semester 6		**30**	**17**	**12:00 p.m.**	**6:00 a.m.**	**7:00 a.m.**	**375h00**	**375h00**		

Overall summary of the training:

EU / V.H.	UEF	EMU	UED	UET	Total
Course	720h00	2:30 p.m.	225h00	180h00	1267h30
T.D.	495h00	10:30 p.m.	---	---	517h30
TP	---	465h00	---	---	465h00
Personal work	1485h00	720h00	25:00	8:00 p.m.	2250h00
other (explain, list,)	---	---	---	---	---
Total	2700h00	1350h00	250h00	200h00	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: UEF1.1
Subject 1: Mathematics 1
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

Mathematics basicsterminal classes(sets, functions, equations, etc.).

Material content:

Chapter 1.Methods of mathematical reasoning (1 week)
1-1 Direct reasoning. 1-2 Reasoning by contraposition. 1-3 Reasoning through the absurd. 1-4 Reasoning by counter example. 1-5 Reasoning by induction.

Chapter 2.Sets, Relations and Applications (2 weeks)
2.1 Set theory. 2-2 Order relation, Equivalence relations. 2-3 Injective, surjective, bijective application: definition of an application, direct image, reciprocal image, characteristic of an application.

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

Chapter 4. Application to elementary functions (3 weeks)
4-1 Power function. 4-2 Logarithmic function. 4-3 Exponential function. 4-4 Hyperbolic function. 4-5 Trigonometric function. 4-6 Reverse function

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

Chapter 6. Linear algebra (4 weeks)
6-1 Laws and internal composition. 6-2 Vector space, base, dimension (definitions and elementary properties). 6-3 Linear application, kernel, image, rank.

Evaluation method:

Continuous monitoring: 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 – 2nd year of the 1st cycle preparatory classes, 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 of higher mathematics 1- Algebra, Dunod.
7- J. Quinet, Elementary course of higher mathematics 2- Usual functions, Dunod.
8- J. Quinet, Elementary course of higher mathematics 3- Integral calculation and series, Dunod.
9- J. Quinet, Elementary course of higher mathematics 4- Differential equations, Dunod.

Semester: 1
Teaching unit: UEF 1.1
Subject 2: Physics 1
VHS: 67h30 (Class: 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

Concepts of mathematics and physics.

Material content:

Math reminders (2 weeks)

1- Equations with dimensions
2-Vector calculation: scalar product (norm), vector product, functions with several variables, derivation. Vector analysis: gradient, rotational operators, etc.

Chapter 1. Cinematic (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 the different coordinate systems. 4- Relative movement.

Chapter 2. Dynamics: (4 weeks)

1- Generality: Mass - Force - Moment of force – Absolute and Galilean Reference. 2- Newton's laws. 3- Principle of conservation of momentum. 4- Differential equation of motion. 5- Kinetic 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.

Evaluation method:

Continuous monitoring: 40%; Exam: 60%.

Bibliographic references:

1. HAS. Gibaud,Mr. Henry;Physics course - Mechanics of the point - Courses 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: UEF1.1
Subject 3: Structure of matter
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

The teaching of this subject allows the student to acquire basic formalisms in chemistry, particularly within the subject describing the atom and the chemical bond, the chemical elements and the periodic table with energy quantification.Make students better able to solve chemistry problems.

Recommended prior knowledge

Basic notions of mathematics and general chemistry.

Material content:

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

Chapter 2 :Main constituents of matter (3 weeks)
Introduction: Faraday's experiment: relationship between matter and electricity,Highlighting the constituents of matter and therefore of the atom and,some physical properties (mass and charge), Rutherford planetary model, Presentation and characteristics of the atom (Symbol, atomic number Z, mass number A, number of protons, neutrons and electrons), Isotopia and relative abundance of the 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 (radiationα,βAndγ), 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, Poly electronic atoms in wave mechanics.

Chapter 5:Periodic classification of elements (3 weeks)
Periodic classification of D. Mendeleiev, Modern periodic classification, Evolution and periodicity of the physicochemical properties of the elements, Calculation of radii (atomic and ionic), successive ionization energies, electron affinity and electronegativity (Mulliken scale) by Slater's rules.

Chapter 6:Chemical bonds(3 weeks)
The covalent bond in Lewis' theory, The polarized covalent bond, dipole moment and partial ionic character of the bond, Geometry of molecules: Gillespie theory or VSEPR, The chemical bond in the quantum model.

Evaluation method:

Continuous monitoring: 40%; Exam: 60%.

Bibliographic references

1. Ouahes, Devallez, General Chemistry, OPU.
2. SS Zumdhal et al., 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 TP 1
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives

Consolidate the theoretical knowledge brought to the course through a certain number of practical manipulations.

Recommended prior knowledge

Concepts of mathematics and physics.

Material content:

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

- Methodology for presenting TP reports and calculating errors.
- Verification of Newton's 2nd law
- Free fall
- Simple pendulum
- Elastic collisions
- Inelastic collisions
- Moment of inertia
- Centrifugal force

Evaluation method:

Continuous control: 100%.

Semester: 1
Teaching unit: UEM1.1
Subject 2: Chemistry TP 1
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Basic concepts of Chemistry.

Material content:

1.Safety in the laboratory

2.Preparing 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: dosage of chloride ions using the Mohr method.

Evaluation method:

Continuous control: 100%

Semester: 1
Teaching unit: UEM1.1
Subject 3: Computer Science 1
VHS: 45h00 (Class: 1h30, TP: 1h30)
Credits: 4
Coefficient: 2

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

Recommended prior knowledge
Basic notions of web technology.

Material content:
Part 1. Introduction to Computer Science (5 weeks)
1- Definition of IT
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. Algorithm and program concepts (10Weeks)
1- Concept of an algorithm
2- Organization chart representation
3- Structure of a program
4- The approach and analysis of a problem
5- Data structure: Constants and variables, Data types
6- Operators: assignment operator, Relational operators, Logical operators, Arithmetic operations, Priorities in operations
7- Input/output operations
8- Control structures: Conditional control structures, Repetitive control structures

Computer science lab 1:
The objective of the practical exercises is to illustrate the concepts taught during the course. These must begin with lessons according to the following schedule:
•Initiation and training sessionsfamiliarization with the computing machine from a hardware and operating systems point of view (exploration of the different functionalities of the OS)
•Introductory practical work on using a programming environment (Editing, Assembly, Compilation, etc.)
• TPapplication of programming techniques seen in class.

Evaluation method:
Continuous monitoring: 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: UEM1.1
Subject 4: Writing methodology
VHS: 3:00 p.m. (Class: 1:00)
Credits: 1
Coefficient: 1

Teaching objectives

Familiarize and train students in current concepts of writing methodology in force in the Science and Technology profession. Among the skills to acquire: Knowing how to present yourself; Know how to write a CV and a cover letter; Know how to position yourself in writing or orally in relation to an opinion or an idea; Master syntax and spelling in writing.

Recommended prior knowledge

Basic French.Basic principle of writing a document.

Material content:

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

Chapter 2. Information search, synthesis and exploitation (3 weeks)
-Searching for information in the library (Paper format: Books, Journals)
-Search for information on the Internet (Digital: Databases; Search engines, etc.).
-Applications

Chapter 3 Writing techniques and procedures (3 weeks)
-Basic Principle of Writing- Punctuation, Syntax, Sentences
-Sentence length
-Division into paragraphs
-Using a neutral style and writing in the third person
-Readability
-Objectivity
-Intellectual rigor and plagiarism

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

Chapter 5. Applications (3 weeks)
Report of practical work

Evaluation method:

Control Review: 100%.

Bibliographic references:

1. J.-L. Lebrun, Practical guide to scientific writing, EDP Sciences, 2007.
2. M. Fayet, Succeeding in your reports, 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: UED1.1
Subject 1: Careers in Science and Technology 1
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Objective of the subject:
Introduce the student, in a first step, to all the sectors covered by the Field of Sciences and Technologies and in a second step a range of professions leading to these sectors. In the same context, this subject introduces the new challenges of sustainable development as well as the new professions that can result from them.

Recommended prior knowledge
None.

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

2.Sectors in Electronics, Telecommunications, Biomedical Engineering, Electrotechnics, Electromechanics, Optics & Precision Mechanics: **(2 weeks)**
- Definitions, areas of application (Home automation,embedded applications for automobiles,Video surveillance, Mobile telephony, Optical fiber, Advanced scientific instrumentation, Imagingand Instrumentationmedical, Giant mirrors, Contact lenses, Transport and distribution of electrical energy, Electricity production plants, Energy efficiency,Maintenance of industrial equipment,Elevators, wind turbines, …
- 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,Energy sector (oil, gas), …
- 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.), Depletion of biodiversity, etc.), SD diagram (Sustainable = Viable + Liveable + Equitable), SD actors (governments , citizens, socio-economic sector, international organizations, etc.), Global nature of SD challenges

6. Sustainable engineering: (4 weeks)
Definition, Principles of sustainable engineering (definitions of: sustainable energy/energy efficiency, sustainable mobility/ecomobility, valorization of resources (water, metals and minerals, etc.), sustainable production), Relevance of sustainable engineering in ST sectors , Relationship between sustainability and engineering, Responsibility of engineers in carrying out sustainable projects, …

Student's personal work for this subject:
The teacher responsible for this subject can let his students know that he can always evaluate them by offering to prepare job descriptions. Ask students to watch at home a popular science film related to the chosen profession (after having given them either the film on electronic media or having indicated to them the internet link to this film) and ask them to then submit a written report or to make an oral presentation of the summary of this film, etc. The improvement of these activities is left to the discretion of the teacher and the training team whoare the only ones capable of defining the best way to take this personal work into account inthe overall score of the final exam.

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

Evaluation mode:
100% review

Bibliographic references:
1- What jobs for tomorrow? Publisher: ONISEP, 2016, Collection: Les Dossiers.
2- J. Douënel and I. Sédès, Choosing a profession according to your profile, Editions d'Organization, 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- Jobs in the aeronautics and space industry, Collection: Course, Edition: ONISEP, 2017.
6- Electronics and robotics professions, Collection: Course, Edition: ONISEP, 2015.
7- The environment and sustainable development professions, Collection: Course, Edition: ONISEP, 2015.
8- Building and public works professions, Collection: Course, Edition: ONISEP, 2016.
9- Transport and logistics professions, Collection: Course, Edition: ONISEP, 2016.
10- Energy professions, Collection: Course, Edition: ONISEP, 2016.
11- Mechanical professions, Collection: Course, Edition: ONISEP, 2014.
12- Chemistry professions, Collection: Course, Edition: ONISEP, 2017.
13- Web professions, Collection: Course, Edition: ONISEP, 2015.
14- Biology professions, Collection: Course, Edition: ONISEP, 2016.

Semester: 1
Teaching unit: UET 3.1
Subject: Ethical and deontological dimension (the foundations)
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge:

None

Material content:

I. Fundamentals –مفاهم أساسية (2 weeks)

Definitions:
1. Moral:
2. Ethics:
3. Ethics "Theory of Duty":
4. The law:
5. Distinction between the different notions
   - A. Distinction between ethics and morality
   - B. Distinction between ethics and professional conduct

II. The Repositories –المرجعيات (2 weeks)

Philosophical references
The religious reference
The evolution of civilizations
The institutional reference

III. The University Franchise –الحرم الجامعي (3 weeks)

The Concept of University Franchises
Regulatory texts
University Franchise Royalties
University campus actors

IV. University Values –القيم الجامعية (2 weeks)

Social Values
Community Values
Professional Values

V. Rights and Duties (2 weeks)

Student Rights
Student homework
Teachers' rights
Obligations of the professor-researcher
Obligations of administrative and technical staff

VI. University Relations (2 weeks)

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

VII. Practices (2 weeks)

Good practices For the teacher
Good practices For the student

Bibliographic references

1. Collection of ethics and professional conduct courses from Algerian universities.
2. BARBERI (J.-F.), 'Morality and corporate law', Les Petites Boîtes, n° 68, June 7, 1995.
3. J. Russ, Contemporary ethical thought, Paris, puf, Que sais-je?, 1995.
4. LEGAULT, GA, Professionalism and ethical deliberation, Quebec, Presses de l'Université du Québec, 2003.
5. SIROUX, D., 'Deontology', in M. Canto-Sperber (dir.), Dictionary of ethics and moral philosophy, Paris, Quadrige, 2004.
6. Prairat, E. (2009). Teaching professions in the age of ethics. Education and Societies, 23.
7. https://elearning.univ-annaba.dz/pluginfile.php/39773/mod_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ontologie.pdf.

Semester: 1

Teaching unit: UET1.1
Subject 1: French language1
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
The aim is to develop the following four skills in this subject: Oral comprehension, Written comprehension and Oral expression, Written expression through reading and studying texts.

Recommended prior knowledge:
Basic French.

Material content:
We offer below a set of themes that deal with fundamental sciences, technologies, economics, social facts, communication, sport, health, etc. The teacher can choose from this list of texts to develop them during the course. Otherwise, he is free to address other themes of his choice. The texts can be borrowed from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular magazines, books, websites, audio and video recordings, etc.
For each text, the teacher helps the student develop their linguistic skills: listening, comprehension, oral and written expression. In addition, he must use this text to identify the grammatical structures that he will develop during the same class session. We recall here, by way of illustration, a set of grammatical structures which 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 can be detailed.

Examples of themes	Grammatical structures
Climate change Pollution The electric car The robots Artificial intelligence Nobel prize Olympic Games Sports at school The Sahara The currency The line work Ecology Nanotechnologies The optical fiber The profession of engineer The power plant Energetic efficiency The smart building Wind energy Solar energy	The punctuation. Proper nouns, Articles. Grammatical functions: The noun, The verb, The pronouns, The adjective, The adverb. The complement pronoun ''the, the, the, him, their, y, en, me, te,...'' Agreements. The negative sentence. Don't... don't, Don't... yet, Don't... again, Don't... ever, Don't... not,... The interrogative sentence. Question with ''Who, What, What'', Question with ''When, Where, How Much, Why, How, Which, Which''. The exclamatory sentence. Reflexive verbs. Impersonal verbs. The tenses of the indicative, Present, Future, past perfect, simple past, Imperfect. …

Evaluation method:
Review: 100%.

Bibliographic references:

1. M. Badefort, Objective: International French Test, Edulang, 2006.
2. O. Bertrand, I. Schaffner, Succeeding in the TCF, Exercises and training activities, 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. M. 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, Presses de l'Université du Québec, 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, Abridged Rules of Grammar and Spelling, Presses de l'Université du Québec, 2001.
12. J.-P. Colin, Simply French, Eyrolles, 2010.
13. Collective, French assessment test, Hachette, 2001.
14. Y. Delatour et al., Practical French grammar in 80 sheets with corrected exercises, Hachette, 2000.
15. Ch. Descotes et al., L'Exercisier: French expression for the intermediate level, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, Sur le Vif, Heinle Cengage Learning, 2011.
17. J. Dubois et al., The essentials – Orthography, Larousse, 2009.

Semester: 1
Teaching unit: UET1.1
Subject 1: English Language1
VHS: 10:30 p.m. (Class: 1h30)
Credit: 1
Coefficient: 1

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

Recommended prior Knowledge:
Basic English.

Contents:
The English syllabus consists of a set of texts containing scientific and technical parts. The chosen texts must be used to study scientific and technical English and Grammar acquisition.
The texts must be selected according to the vocabulary built up, familiarization with both scientific and 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., Classification
Steam Locomotives.	The Impersonal Passive
Condensation and Condensers.	Passive Verb + By + Noun (agent)
Centrifugal Governors.	Too Much or Too Little
Impulse Turbines.	Instructions (Imperative)
The Petro Engine.	Requirements and Necessity
The Carburation System.	Means (by + Noun or –ing)
The Jet Engine.	Time Statements
The Turbo-Prop Engine.	Function, Duty
Aerofoil.	Alternatives

Fashion rating:
Review: 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 of the press: Vocabulary and expressions of the economic, social and political world, Fernand Nathan, 2006.

Semester: 2
Teaching unit: UEF1.2
Subject 1: Mathematics 2
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

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

Material content:

Chapter 1: Matrices and determinants (3 weeks)
1-1 Matrices (Definition, operation). 1-2 Matrix associated with a linear application. 1-3 Linear application associated with a matrix. 1-4 Change of base, passage matrix.

Chapter 2: Systems of linear equations (2 weeks)
2-1 General. 2-2 Study of all the solutions. 2-3 Methods for solving a linear system. Resolution by Cramer's method. Solved by the inverse matrix method. Resolution by Gauss' method

Chapter 3: Integrals (4 weeks)
3-1Indefinite integral, property.3-2Integration of rational functions.3-3Integration of exponential and trigonometric functions.3-4The integral of polynomials.3-5Integration defined

Chapter 4: Differential equations (4 weeks)
4-1 ordinary differential equations. 4-2 differential equations of order 1. 4-3 differential equations of order 2. 4-4 ordinary differential equations of second order with constant coefficient.

Chapter 5: Functions with several variables (2 weeks)
5-1 Limit, continuity and partial derivatives of a function. 5-2 Differentiability. 5-3 Double, triple integrals.

Evaluation method:

Continuous monitoring: 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. Piskounov, Differential and integral calculus, Volume 1, Moscow edition
6- J. Quinet, Elementary course of higher mathematics 3- Integral calculation and series, Dunod.
7- J. Quinet, Elementary course of higher mathematics 4- Differential equations, Dunod.

8- J. Quinet, Elementary course of higher mathematics 2- Usual functions, Dunod.
9- J. Quinet, Elementary course of 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 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives
Introduce the student to the physical phenomena underlying the laws of electricity in general.

Recommended prior knowledge
Mathematics 1, Physics 1.

Material content:
Mathematical reminders:(1 week)
1- Elements of length, surface, volume in Cartesian, cylindrical, spherical coordinate systems. Solid angle,The 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 flow. 5- Gauss's theorem. 6- Conductors in balance. 7- Electrostatic pressure. 8- Capacity of a conductor and a capacitor.

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

Chapter III. Electromagnetism :(4 weeks)
1- Magnetic field: Definition of a magnetic field,Biot and Savart's law, Ampère's theorem, Calculation of magnetic fields created by permanent currents.
2- Induction phenomena: Induction phenomena (circuit in a variable magnetic field and mobile circuit in a magnetic fieldpermanent), FLorentz gold,FLaplace orce, Faraday's law, Lenz's law, Application to coupled circuits.

Evaluation method:
Continuous monitoring: 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: UEF1.2
Subject 3: Thermodynamics
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

Provide the necessary foundations of classical thermodynamics with a view to applications to combustion and thermal machines. Homogenize student knowledge. The skills to be understood 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.

Material content:

Chapter 1: General information on thermodynamics (3 weeks)

1-Fundamental properties of state functions. 2- Definitions of thermodynamic systems and the external environment. 3- Description of a thermodynamic system. 4- Evolution and states of thermodynamic equilibrium 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 ideal gas laws.

Chapter 2: The 1st principle of thermodynamics: (3 weeks)

1. Work, heat, internal energy, concept of energy conservation. 2. The 1st principle of thermodynamics: statement, concept of internal energy of a system, application to the ideal gas, the enthalpy function, heat capacity, reversible transformations (isochoric, isobaric, isothermal, adiabatic).

Chapter 3: Applications of the first law of thermodynamics to thermochemistry (3 weeks)

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

Chapter 4: The 2nd law of thermodynamics (3 weeks)

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

Chapter 5: The 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- Energy and free enthalpy. 3- Chemical balances

Evaluation method:

Continuous monitoring: 40%; Exam: 60%.

Bibliographic references:

1. C. Coulon, S. Le Boiteux S. and P. Segonds, Physical Thermodynamics - Courses and exercises with solutions, Edition Dunod.
2. HB Callen, Thermodynamics, Course, Edition John Wiley and Sons, 1960

3. R. Clerac, C. Coulon, P. Goyer, S. Le Boiteux & C. Rivenc, Thermodynamics, Courses and tutorials in thermodynamics, University Bordeaux 1, 2003
4. O. Perrot, Thermodynamics Course IUT of Saint-Omer Dunkirk, 2011
5. CL Huillier, J. Rous, Introduction to thermodynamics, Edition Dunod.

Semester: 2
Teaching unit: UEM 1.2
Subject 1: Physics TP 2
VHS: 45h00 (TP: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

Consolidate the theoretical concepts covered in the Physics 2 course through Practical Work sessions.

Recommended prior knowledge

Mathematics 1, Physics 1.

Material content:

5 manipulations at least (3h00 / 15 days)

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

Evaluation method:

Continuous control: 100%

Semester: 2
Teaching unit: UEM1.2
Subject 2: Chemistry TP 2
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives

Consolidate the theoretical concepts covered in the Thermodynamics course through Practical Work sessions.

Recommended prior knowledge

Thermodynamics.

Material content:

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 melting 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.

Evaluation method:

Continuous control: 100%

Semester: 2
Teaching unit: UEM1.2
Subject 3: Computer Science 2
VHS: 45h00 (Class: 1h30, TP: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

Master basic programming and algorithmic techniques. Acquire the fundamental concepts of computer science. The skills to be acquired are: Programming with a certain autonomy; The design of 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.

Material content:

Chapter 1 :Indexed variables (4Weeks)
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, call of functions
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 (concept of fields)
3- Manipulation of record structures
4- Concept of file
5- File access modes
6- Reading and writing to a file

Computer science lab 2:

Plan a certain number of practical exercises to concretize the programming techniques seen during the course.
- TPapplication of programming techniques seen in class.

Evaluation method:

Continuous monitoring: 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: UEM1.2
Subject 4: Presentation methodology
VHS: 3:00 p.m. (Class: 1:00)
Credits: 1
Coefficient: 1

Teaching objectives

Give the main bases for a successful oral presentation.Among the skills to acquire: Knowing how to prepare a presentation; Know how to present a presentation; Know how to capture the attention of the audience; Learn about the pitfalls of plagiarism and understand intellectual property regulations.

Recommended prior knowledge

Expression and communication techniques and writing methodology.

Material content:

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

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

Chapter 3: Plagiarism and Intellectual Property (3 weeks)
1- Plagiarism: Definitions of plagiarism, sanction of 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)
- Present written work. Applications: presentation of an oral presentation.

Evaluation 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, Succeeding in a presentation. Prepare impactful slides and communicate well in public. Eyrolles, 2009.
5. H. Biju-Duval, C. Delhay, All speakers, Eyrolles, 2011.
6. C. Eberhardt, Practical work with PowerPoint. Create and layout slides, Dunod, 2014.
7. F. Cartier, Written and oral communication, Edition GEP- Groupe Eyrolles, 2012.
8. L. Levasseur, 50 exercises for speaking in public, Eyrolles, 2009.
9. S. Goodlad, Speaking technically – A Handbook for Scientists, Engineers, and Physicians on How to Improve Technical Presentations, Imperial College Press, 2000.
10. M. Markel, Technical communication, eleventh edition, Bedford/St Martin's, 2015.

Semester: 2
Teaching unit: UED1.2
Subject 1: Careers in Science and Technology 2
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Objective of the subject:
Introduce the student, in a first step, to all the sectors covered by the Field of Sciences and Technologies and in a second step a range of professions leading to these sectors. In the same context, this subject introduces the student to the new challenges of sustainable development as well as the new professions that can result from them.

Recommended prior knowledge
None.

Content of the material:
1.Industrial Hygiene and Safety (HSI) sectorsand Gmining industry: (2 weeks)
- Definitions andapplication areas (Security of goods 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, Smart buildings,Safety in transport, 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, Large road and rail infrastructures, Bridges, Airports, Dams, Drinking water supply and Sanitation, Hydraulic flows, Water resources management, Public works and land use planning, Smart cities, …)
- Role of the specialist in these areas.

4.Aeronautics, Mechanical Engineering, Maritime Engineering and Metallurgy sectors: (2 weeks)
- Definitions and areas of application (Aeronautics, Avionics, Automotive industry, Ports, Dykes,Production of industrial equipment,Steel industry,Metal processing,…)
- Role of the specialist in these areas.

5. Approaches to sustainable production: (2 weeks)
Industrial ecology, Remanufacturing, Ecodesign.

6. Measure 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 company as an economic entity (concepts of profit, costs, performance) and social (concept of corporate social responsibility), Impact of economic activities on the environment (examples), Issues/benefits of SD for the company, Means of engagement in a SD approach (e.g. ISO 14001 certification, labeling (e.g. energy labeling, Ecolabel, Organic/AB Label, FSC Label, etc.), strategic SD plan, Global Reporting Initiative (GRI)…), Global rankings of the most sustainable companies (Dow Jones Sustainable Index, Global 100, ….), Company case studiesefficient/eco-responsible in the ST sectors (e.g. SIEMENS, Cisco, Henkel AG & Co, TOTAL, Peugeot, Eni SPA ...).

Student's personal work for this subject:

- Work in groups/pairs: Reading articles on sustainable development and/or reports from successful and sustainable companies and developing summaries of the main actions undertaken in the field of SD.

Examples of documents for reading and synthesis:

- 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-organizations-2009-1-page-201.htm)
- Mireille Chiroleu-Assouline. Corporate sustainable development strategies. Ideas, The journal of economic and social sciences, CNDP, 2006, p 32-39 (free online access:http://halshs.archives-ouvertes.fr/hal-00306217/document)
- Web page on environmental and societal commitmentsTOTAL:https://www.total.com/fr/engagement
- Innovationssustainable mobilityfrom the PSA group:http://www.rapportannuel.groupe-psa.com/rapport-2015/engagements/dessolutions-innovantes-pour-des-transports-durables/

Evaluation mode:

100% review

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: Human Sciences, 2017.

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

4- L. Grisel and Ph. Osset, Life cycle analysis of a product or service: Applications and putting into practice, 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-balance, 3rd Edition: PPUR, 2017.

6- G. Pitron and H. Védrine, The war over rare metals: The hidden face of the energy and digital transition, Edition: Links that liberate, 2018.

7- The environment and sustainable development professions, Collection: Course, Edition: ONISEP, 2015.

Semester: 2
Teaching unit: UET1.2
Subject 1: French language 2
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
The aim is to develop the following four skills in this subject: Oral comprehension, Written comprehension, Oral expression, Written expression through reading and studying texts.

Recommended prior knowledge:
Basic French.

Material content:
We offer below a set of themes that deal with fundamental sciences, technologies, economics, social facts, communication, sport, health, etc. The teacher can choose from this list of texts to develop them during the course. Otherwise he is free to address other themes of his choice. The texts can be borrowed from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular magazines, books, websites, audio and video recordings, etc.
For each text, the teacher helps the student develop their linguistic skills: listening, comprehension, oral and written expression. In addition, he must use this text to identify the grammatical structures that he will develop during the same class session. We recall here, by way of illustration, a set of grammatical structures which 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 can be detailed.

Examples of themes	Grammatical structures
Pharmaceutical industry Food industry The national employment agency ANEM Sustainable development Renewable energies Biotechnology The stem cells Road safety Dams Water – Water resources Avionics 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	The subjunctive. The conditional. The imperative. The past participle. Passive form. Possessive adjectives, Possessive pronouns. Demonstratives, Demonstrative pronouns. The expression of quantity (several, a few, enough, many, more, less, as much, etc.). Numbers and measurements. The pronouns ''who, that, where, whose''. Subordinate preposition of time. The cause, the consequence. The goal, the opposition, the condition. Comparisons, superlatives. …

The advertisement Autism	

Evaluation method:

Review: 100%.

Bibliographic references:

1. M. Badefort, Objective: International French Test, Edulang, 2006.
2. O. Bertrand, I. Schaffner, Succeeding in the TCF, Exercises and training activities, 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. M. 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, Presses de l'Université du Québec, 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, Abridged Rules of Grammar and Spelling, Presses de l'Université du Québec, 2001.
12. J.-P. Colin, Simply French, Eyrolles, 2010.
13. Collective, French assessment test, Hachette, 2001.
14. Y. Delatour et al., Practical French grammar in 80 sheets with corrected exercises, Hachette, 2000.
15. Ch. Descotes et al., L'Exercisier: French expression for the intermediate level, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, Sur le Vif, Heinle Cengage Learning, 2011.
17. J. Dubois et al., The essentials – Orthography, Larousse, 2009.

Semester: 2
Teaching unit: UET1.2
Subject 1: English Language 2
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

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

Recommended prior Knowledge:
Basic English.

Contents:
The English syllabus consists of a set of texts containing scientific and technical parts. The chosen texts must be used to study scientific and technical English and Grammar acquisition.
The texts must be selected according to the vocabulary built up, familiarization with both scientific and 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**
Radioactivity. Chain Reaction. Reactor Cooling System. Conductor and Conductivity. Induction Motors. Electrolysis. Liquid Flow and Metering. Liquid Pumps. Petroleum. Road Foundations. Rigid Pavements. Batteries for Foundations. Suspension Bridges.	Explanation of Cause Results Conditions (if), Conditions (Restrictive) Eventuality Manner When, Once, If, etc. + Past Participle It is + Adjective + to Ace It is + Adjective or Verb + that… Similarity, Difference In Spite of, Although Formation of Adjectives Phrasal Verbs

Fashion rating:
Review: 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 of the press: Vocabulary and expressions of the economic, social and political world, Fernand Nathan, 2006.

Semester: 3
Teaching unit: UEF 2.1.1
Subject 1:Mathematics 3
VHS: 67h30 (Class: 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 convergence conditions as well as the different types of convergence.

Recommended prior knowledge

Mathematics 1 and Mathematics 2

Content of the material:

Chapter 1: Simple and multiple integrals **3 weeks**

1.1 Reminders on the Riemann integral and on 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 weeks**

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

Chapter 3: Differential equations **2 weeks**

3.1 Reminder 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 Integer series, Fourrier series.

Chapter 5: Fourier Transform **3 weeks**

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

Chapter 6: Laplace Transformation **2 weeks**

6.1 Definition and properties. 6.2 Application to the resolution of differential equations.

Evaluation mode:

Continuous monitoring: 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. Piskounov, Differential and integral calculus, Volume 1, Moscow edition
6- J. Quinet, Elementary course of higher mathematics 3- Integral calculation and series, Dunod.
7- J. Quinet, Elementary course of higher mathematics 4- Differential equations, Dunod.

8- MR Spiegel, Laplace Transforms, Courses and problems, 450 Corrected exercises, McGraw-Hill.

Semester: 3
Teaching unit: UEF 2.1.1
Subject 2: Waves and Vibrations
VHS: 45h00 (Class: 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 split into two parts, the Waves part and the Vibrations part, which can be approached independently of the other. In this regard and due to the consistency of this subject in terms of content, it is advisable to approach this subject in this order: Waves and then Vibrations for students in the Electrical Engineering sectors (Group A). While for students of Groups B and C (Civil Engineering, Mechanical Engineering and Process Engineering), it is wise to start with Vibrations. In any case, the teacher is called upon, to do his 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 go over all the parts of the course which require demonstrations or theoretical developments and to focus only on the application aspects. Furthermore, demonstrations can be the subject of auxiliary work to be asked of students as activities within the framework of the student's personal work. On this subject, consult the paragraph ''G- Student evaluation through continuous assessment and personal work'' present in this training offer.*

Part A: Vibration

Chapter 1: Introduction to Lagrange equations **2 weeks**

1.1 Lagrange equations for a particle
1.1.1 Lagrange equations
1.1.2 Case of conservative systems
1.1.3 Case of speed-dependent friction forces
1.1.4 Case of an external force depending on time
1.2 System with several degrees of freedom.

Chapter 2: Free oscillations of systems at a degree offreedom **2 weeks**

2.1 Undamped oscillations
2.2 Free oscillations of damped systems

Chapter 3: Forced oscillations of systems with one degree of freedom 1 week

3.1 Differential equation
3.2 Mass-spring-damper system
3.3 Solution of the differential equation
3.3.1 Harmonic excitation
3.3.2 Periodic excitation
3.4 Mechanical impedance

Chapter 4: Free oscillations of systems with two degrees of freedom 1 week

4.1 Introduction
4.2 Systems with two degrees of freedom

Chapter 5: Forced oscillations of systems with two degrees of freedom 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 2 weeks
1.1 General and basic definitions
1.2 Propagation equation
1.3 Solution of the propagation equation
1.4 Sinusoidal traveling wave
1.5 Superposition of two progressive sinusoidal waves

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

Chapter 3: Acoustic waves in fluids 1 week
3.1 Wave equation
3.2 Speed of sound
3.3 Sinusoidal traveling wave
3.4 Reflection-Transmission

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

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

Bibliographic references:

1. H. Djelouah; Vibrations and Mechanical Waves – Courses & Exercises (USTHB University website:perso.usthb.dz/~hdjelouah/Coursvom.html)
2. T. Becherrawy; Vibrations, waves and optics; Hermes science Lavoisier, 2010
3. J. Brac; Propagation of acoustic and elastic waves; Hermès science Publ. Lavoisier, 2003.
4. R. Lefort; Waves and Vibrations; Dunod, 2017
5. J. Bruneaux; Vibrations, waves; Ellipses, 2008.
6. J.-P. Perez, R. Carles, R. Fleckinger; Electromagnetism Foundations and Applications, 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 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Explain the calculation, analysis and interpretation of electronic circuits. Know 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 material:

The number of weeks displayed are indicated for information purposes only. It is obvious that the course manager is not required to strictly respect this dimensioning 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 adaptation. Passive filters (low pass, high pass, etc.), Gain curve, Phase curve, Cutoff frequency, Bandwidth.

Chapter 3. Diodes **3 weeks**

Basic reminders of the physics of semiconductors: Definition of a semiconductor, Crystalline Si, Doping concepts, N and P semiconductors, PN junction, Constitution and operation of a diode, direct and reverse polarization, Current characteristic -voltage, static and variable regime, Equivalent diagram. Applications of diodes: Single and double alternation rectification. Voltage stabilization by the Zener diode. Clipping, Other types of diodes: Varicap, LED, Photodiode.

Chapter 4. Bipolar Transistors **3 weeks**

Bipolar transistors: Transistor effect, operating modes (blocking, saturation, etc.), Static characteristics network, Polarizations, Load line, Rest point, etc. Study of the three fundamental assemblies: EC, BC, CC, Equivalent diagram, Gain in voltage, Gain in decibels, Bandwidth, Current gain, Input and output impedances. Study of amplifiers with several LF stages in static and dynamic conditions, connection capacitors, decoupling capacitors. Other uses of the transistor: Darlington assembly, switching transistor, etc.

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

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

Evaluation mode:

Continuous monitoring: 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: The Components, Volume 1, McGraw-Hill, 1982.
5. P. Horowitz, Treatise on Analogue and Digital Electronics, Volumes 1 and 2, Publitronic-Elektor, 1996.
6. M. Ouhrouche, Electric circuits, Presses international Polytechnique, 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 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge:

Basic electricity concepts.

Content of the subject:

Chapter 1. Mathematical reminders about complex numbers (NC) (1Week)
Cartesian form, conjugated 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 NC electricity.

Chapter 2. Reminders on the fundamental laws of electricity (2 weeks)
Continuous regime: electric dipole, association of dipoles R, C, L.
Harmonic regime: representation of sinusoidal quantities, average and effective values, Fresnel representation, complex notation, impedances, powers in sinusoidal regime (instantaneous, active, apparent, reactive), Boucherot's theorem.
Transient regime: RL circuit, RC circuit, RLC circuit, charging and discharging of a capacitor.

Chapter 3. Electrical circuits and powers (3 weeks)
Single-phase circuits and electrical powers. Three-phase systems: Balanced and unbalanced (symmetrical components) and electrical powers.

Chapter 4. Magnetic circuits (3 weeks)
Magnetic circuits in sinusoidal alternating regime. Self and mutual inductances. Magnetic electrical analogy.

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

Chapter 6. Introduction to electrical machines (3 weeks)
General information on electrical machines. Principle of operation of the generator and the engine. Power balance and efficiency.

Evaluation mode:

Continuous monitoring: 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. Fouille,Electrotechnics for the Use of Engineers, 10th edition, Dunod, 1980.
3. C. François, Electrical engineering, Ellipses, 2004
4. L. Lasne, Electrotechnique, Dunod, 2008

5. J. Edminister, Theory and Applications of Electric Circuits, McGraw Hill, 1972
6. D. Hong, Electrical circuits and measurements, Dunod, 2009
7. M. Kostenko, Electric Machines - Volume 1, Volume 2, Editions MIR, Moscow, 1979.
8. M. Jufer, Electromechanics, Presses polytechniques et universitaire romandes- Lausanne, 2004.
9. A. Fitzgerald, Electric Machinery, McGraw-Hill Higher Education, 2003.
10. J. Lesenne, Introduction to in-depth 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 (Class: 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 over a finite universe and random variables.

Recommended prior knowledge

Mathematics 1 and Mathematics 2

Material content:

Part A: Statistics

Chapter 1: Basic Definitions **(1 week)**

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

Chapter 2: One-variable statistical series **(3 weeks)**

A.2.1 Number, Frequency, Percentage.
A.2.2 Cumulative number, Cumulative frequency.
A.2.3 Graphical representations: bar chart, circular chart, bar chart. Polygon of numbers (and frequencies). Histogram. Cumulative curves.
A.2.4 Position characteristics
A.2.5 Dispersion characteristics: extent, variance and standard deviation, coefficient of variation.
A.2.6 Shape characteristics.

Chapter 3: Statistical series in two variables **(3 weeks)**

A.3.1 Data tables (contingency table). A cloud of dots.
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 fit.

Part B: Probabilities

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

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

Chapter 2: Introduction to Probability **(2 weeks)**

B.2.1Algebra of events
B.2.2Definitions
B.2.3Probable spaces
B.2.4General probability theorems

Chapter 3: Conditioning and independence **(1 week)**

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

Chapter 4: Random variables **(1 week)**
B.4.1Definitions and properties,
B.4.2Distribution function,
B.4.3Expectation,
B.4.4Covariance and moments.

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

Evaluation mode:

Continuous monitoring: 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 calculation and statistics. Handout ENSTA, 2008.
3. W.Feller. an Introduction to Probability Theory and its Applications, Volume 1. Wiley & Sons, Inc., 3rd edition, 1968.
4. G. Grimmett, D. Stirzaker, Probability and Random Processes, Oxford University Press, 2nd edition, 1992.
5. J. Jacod and P. Protter, Probability Essentials, Springer, 2000.
6. A. Montfort. Mathematical statistics course. Economica, 1988.
7. A. Montfort. Introduction to statistics. Polytechnic School, 1991

Semester: 3
Teaching unit: UEM2.1
Subject 2:Computer science 3
VHS: 10:30 p.m. (TP: 1:30 a.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 digital 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.)

Lab 2: Script Files and Types of Data and Variables (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)

Lab 6: Function files (2 weeks)

TP 7: Graphics (Management of graphic windows, plot) (2 weeks)

TP 8: Using toolbox (2 weeks)

Evaluation mode:

Continuous control: 100%.

Bibliographic references:

1. Jean-Pierre Grenier,Getting started in algorithms with MATLAB and SCILAB,Ellipses,2007.
2. Laurent Berger, Scilab from theory to practice, 2014.
3. Bégyn Arnaud, Gras Hervé, Grenier Jean-Pierre, Programming and simulation in Scilab, 2014.
4. Thierry Audibert,Amar Oussalah,Maurice Nivat, Computer science: Programming and scientific calculation 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 TP
VHS: 10:30 p.m. (TP: 1:30 a.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

Fundamental electronics. Fundamental electrical engineering.

Content of the material:

The TP teacher is required to carry out at least 3 Electronics TPs and 3 Electrical Engineering TPs from the list of TPs offered below:

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

Electrotechnical TP 1
TP 1: Single-phase voltage and current measurement
TP 2: Three-phase voltage and current measurement
TP 3: Three-phase active and reactive power measurement
TP 4: Magnetic circuits (hysteresis cycle)
TP 5: Transformer testing
TP 6: Electrical machines (demonstration).

Evaluation mode:

Continuous control: 100%

Bibliographic references:

Semester: 3
Teaching unit: UEM 2.1
Subject 4:TP Waves and vibrations
VHS: 3:00 p.m. (TP: 1:00 a.m.)
Credits: 1
Coefficient: 1

Teaching objectives

The objectives assigned by this program concern the initiation of students to put 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: Groove pulley according to Hoffmann
TP8: Electromechanical systems (The electrodynamic loudspeaker)
TP9: Pohl's pendulum
TP10: Propagation of longitudinal waves in a fluid.

Noticed: It is recommended to choose at least 5 TPs among the 10 offered.

Evaluation mode:

Continuous control: 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: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives
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, Automatics, Telecommunications, … etc.

2- Impact of Electrical Engineering on the development of society: Advances in Microelectronics, Automation and supervision, Robotics, Telecommunications development, Instrumentation in health development, …

Evaluation mode: 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. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge:

Concepts of energy and environment.

Content of the subject:

Chapter 1: The different energy resources

Chapter 2: Energy storage

Chapter 3: Consumption, reserves and developmentsResourceenergy

Chapter 4: The different types of pollution

Chapter 5: Detection and treatmentof thepollutants and waste

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

Evaluation mode:

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: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This course must allow the student to acquire a fairly significant level of language capable of allowing him to use a scientific document and talk about his specialty and his sector in English, at least, with a certain ease and clarity. .

Recommended prior knowledge:

English 1 and English 2

Content of the material:

- Oral comprehension and oral expression, acquisition of vocabulary, grammar, ... etc.

-Nouns and adjectives, comparisons, following and giving instructions, identifying things.

-Use of numbers, symbols, equations.

- Measurements: Length, surface, volume, power, ... etc.

- Describe scientific experiments.

- VScharacteristics of scientific texts.

Evaluation mode:

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: UEF2.2.1
Subject 1:Fundamental electrical engineering 2
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

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

Fundamental electrical engineering 1

Content of the material:

Chapter 1: Reminders on magnetostatics and magnetic circuits (1 week)

Chapter 2: Transformer (4 weeks)

General, Operating principle of the single-phase transformer, The ideal transformer, Calculation of the induced electromotive force, Impedance adaptation, The real transformer, The transformer in the Kapp approximation, Evaluation of the secondary voltage drop, Energy balance and efficiency, Measures for calculating efficiency, Three-phase transformer, Different types of coupling and hourly index.

Chapter 3: Direct current machines (4 weeks)

General, Operating principle – Constitution, DC generator – characteristic equations, Calculation of the electromotive force and torque, The different excitation modes, DC motor – operating principle, energy balance and efficiency.

Chapter 4: Synchronous machines (3 weeks)

General, Concept of rotating field, Operating principle – Constitution of themachine, Alternator operation, Magnetic reaction of the armature, Behn diagramEschenburg, Energy balance and efficiency.

Chapter 5: Asynchronous machines (3 weeks)

Operating principle – Constitution of asynchronous machines, Equation and equivalent single-phase diagram, Torque and mechanical characteristic, Energy balance and efficiency, Simplified circle diagram.

Evaluation mode:

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

Bibliographic references:

1. Jacques LESENNE, Francis NOTELET and Guy SEGUIER, Introduction to in-depth electrical engineering, Technique and Documentation, 1981.
2. Pierre MAYE, Industrial electric motors, Dunod, 2005.
3. R. Annequin and J. Boutigny, Course in physical sciences, electricity 3, Vuibert.
4. M. Kouznetsov, Foundations of electrical engineering.
5. H. Lumbroso, Solved problems on electrical circuits, Dunod.

6. JP Perez, R. Carles and R. Fleekinger, Electromagnetism Fundamentals and Applications, 3rd Edition, 1997.
7. A. Fouillé, Electrotechnique for the Use of Engineers, Dunold, 1963
8. M. Kostenko L. Piotrovsky, Electric Machines - Volume 1, Volume 2, Editions MIR, Moscow, 1979.
9. MARCEL Jufer, Electromechanics, Presses Polytechniques et Universitaires Romandes-Lausanne, 2004.
10. AE Fitzgerald, Charles Kingsley Jr., Stephen D. Umans, Electric Machinery, McGraw-Hill Higher Education, 2003.
11. Edminster, Theory and Applications of Electric Circuits, Mc.GrawHill.

Semester: 4
Teaching unit: UEF 2.2.1
Subject 2:Combinatorial and sequential logic
VHS: 45h00 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Know the usual combinational circuits. Know how to design some applications of combinatorial 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 material:

The number of weeks displayed are indicated for information purposes only. It is obvious that the course manager is not required to strictly respect this dimensioning or the arrangement of the chapters.

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

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

Chapter 2: Number 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 detector and corrector codes, ascii code, etc.) , arithmetic operations in binary code.

Chapter 3: Combinatorial transcoder circuits 2 weeks

Definitions, decoders, priority encoders, transcoders, Cascading, Applications, Analysis of the technical sheet of a decoder integrated circuit, List of decoding integrated circuits.

Chapter 4: Combinational switching circuits 2 weeks

Definitions, multiplexers, demultiplexers, Cascading, Applications, Analysis of the technical sheet of a switching integrated circuit, List of integrated circuits.

Chapter 5: Combinatorial comparison circuits 2 weeks

Definitions, 1-bit, 2-bit and 4-bit comparison circuit, Cascading, Applications, Datasheet analysis 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 applications with flip-flops: Frequency divider by n, Pulse train generator, etc.
It is advisable to present the truth table, examples of timing diagrams as well as the limits and imperfections for each flip-flop.

Chapter 7: Counters 2 weeks

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

Chapter 8. The Registers **1 week**

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

Evaluation mode:

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

Bibliographic references:

1- J. Letocha, Introduction to logic circuits, McGraw Hill Edition.
2- JC Lafont, Courses 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: combinatorial logic and technology, McGraw Hill, 1987
9- C. Brie, Combinatorial and sequential logic, Ellipses, 2002.
10-JP. Ginisti, Combinatorial logic, Paris, PUF (coll. “Que sais-je?” 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:Numerical methods
VHS: 45h00 (Class: 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 **(2 weeks)**
1. General introduction, 2. Lagrange polynomial, 3. Newton polynomials.

Chapter 3.Function approximation: **(2 weeks)**
1. Approximation method and root mean square. 2. Orthogonal or pseudo-Orthogonal systems. Approximation by orthogonal polynomials, 3. Trigonometric approximation.

Chapter 4. Digital integration (2 weeks)
1. General introduction, 2. Trapezoid method, 3. Simpson method, 4. Quadrature formulas.

Chapter 5. Solving ordinary differential equations
(Problem of the initial condition or of Cauchy) (2 weeks)
1. General introduction, 2. Euler method, 3. Improved Euler method, 4. Runge-Kutta method.

Chapter 6. Direct solution method for systems of linear equations (2 Weeks)
1. Introduction and definitions, 2. Gauss method and pivot, 3. LU factorization method, 4. Choeleski MMt factorization method, 5. Thomas algorithm (TDMA) for three-diagonal systems.

Chapter 7. Approximate solution method for systems of linear equations
(2 weeks)
1. Introduction and definitions, 2. Jacobi method, 3. Gauss-Seidel method, 4. Use of relaxation.

Evaluation mode:

Continuous monitoring: 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, Digital 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. Presses Universitaires de Grenoble, 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:Signal theory
VHS: 45h00 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge:

Basic mathematics course.

Content of the subject:

Chapter 1. General information about signals **(3 weeks)**

Objectives of signal processing. Areas of use. Classification of signals (morphological, spectral, etc.). Deterministic signals (periodic and non-periodic) and random signals (stationary and non-stationary). Causality. Concepts of power and energy. Basic functions in signal processing (measurement, filtering, smoothing, modulation, detection, etc.). Examples of basic signals (rectangular, triangular pulse, ramp, step, sign, Dirac, etc.)

Chapter 2. Fourier analysis (4 weeks)

Introduction, Mathematical reminders (dot product, Euclidean distance, linear combination, orthogonal base, etc.). Approximation of signals by a linear combination of orthogonal functions. Fourier series, Fourier transform, Properties. Parseval's theorem. Fourier spectrum of periodic (discrete spectrum) and non-periodic (continuous spectrum) signals.

Chapter 3. Laplace Transform **(3 weeks)**

Definition. Properties of the Laplace Transform. Signal/system relationship. Application to linear and translation invariant systems or SLIT (Temporal and Frequency Analysis).

Chapter 4. Convolution Product **(2 weeks)**

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

Chapter 5. Signal Correlation (3 weeks)

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

Evaluation mode:

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

Bibliographic references:

1. S. Haykin, “Signals and systems”, John Wiley & Sons, 2nd ed., 2003.
2. AV Oppenheim, “Signals and systems”, Prentice-Hall, 2004.
3. F. de Coulon, “Theory and processing of signals”, Edition PPUR.
4. F. Cottet, “Signal processing and data acquisition, Courses and solved exercises”, Dunod.
5. B. Picinbono, “Theory of signals and systems with solved problems”, Edition Bordas.
6. Mr. Benidir,“Signal Theory and Processing, volume 1: Representation of signals and systems - Courses and corrected exercises, Dunod, 2004.
7. Mr. Benidir,“Signal Theory and Processing, volume 2: Basic methods for signal analysis and processing - Courses and corrected exercises, Dunod, 2004.
8.J. Max, Signal processing

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

Teaching objectives:

Introduce the student to techniques for 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:

The number of weeks displayed are indicated for information purposes only. It is obvious that the course manager is not required to strictly respect this dimensioning or the arrangement of the chapters.

Chapter 1. Measurements, quantities and uncertainties 5 weeks

Introduction, Quantity, Standard, Systems of units, Table of multiples and submultiples, Equations with dimensions, Useful formulas, Measurement precision, Measurement error, Classification of errors, Uncertainties in indirect measurements, Qualities of measuring devices, Calibration of measuring devices, Graphic symbols of measuring devices, General measuring methods (deviation, zero, resonance methods), Application exercises.

Chapter 2. Measurement methods 6 weeks

1. Voltage measurements: Direct methods of voltage measurements, Alternative voltage measurements, Indirect method of voltage measurements using the opposition method.
2. Measurement of currents: Direct method of measuring currents, Use of simple Shunt.
3. Resistance measurements: Classification of resistances, Voltammetric method, Zero method: The Wheatstone Bridge, Measurement of very large resistances by the pressure loss method.
4. Impedance measurements: Capacitance measurements, Inductance measurement, AC bridges.
5. Continuous Power Measurements: Fundamental relationship, Ammeter and voltmeter method, Continuous electrodynamic wattmeter.
6. AC Power Measurements: Instantaneous power and average power, Complex power, apparent power, active power and reactive power, AC electrodynamic watt meter, 3 voltmeter method for active power, Method of direct measurement of reactive power, Method of indirect reactive power measurements
7. Phase shift measurements: Direct measurement of phase shifts with the oscilloscope, Measurement of phase shifts with Lissajous figures.
8. Measurements of frequencies and periods: Direct measurement of frequency with the oscilloscope, Measurement of frequencies with Lissajous figures, Measurement of frequencies by the frequency meter method, Measurement of frequencies by the period meter method, Application exercises.

Chapter 3. Measuring devices 4 weeks

Introduction
Analog measuring devices: Classification of deflection devices, The moving frame galvanometer, Structure of the magnetoelectric ammeter, Structure of the magnetoelectric voltmeter, Operation of the alternating electrodynamic wattmeter
Digital measuring devices: Analog-to-digital converters (ADC), Principle of operation of a digital measuring device, Examples of digital measuring devices (The multimeter, the oscilloscope, etc.).
TP Electrical and electronic measurements:

TP No. 1: Resistance measurement:

Measure resistances 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:

Measure 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 the capacitance measurement 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: Phasemeter and oscilloscope.

TP No. 5: Single-phase power measurement:

Measure the resistances using the following 5 methods: wattmeter, Cosϕmeter, 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 the resistance measurement using the following methods: Star system and triangle system, balanced and unbalanced.

Evaluation mode:

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

Bibliographic references:

1- M. Cerr, Industrial instrumentation: T.1, Edition Tec and Doc.
2- M. Cerr, Industrial instrumentation: T.2, Edition Tec and Doc.
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, Edition Dunod.
14-A. Leconte, Measurements in electrotechnics (Document D 1 501), Engineering techniques.

SourcesInternet :

- 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/apparatusdemesure

Semester: 4
Teaching unit: UEM2.2
Subject 2:TPFundamental electrical engineering 2
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives
Consolidate the knowledge acquired during the fundamental electronics and electrotechnical disciplines, through practical work, to better understand and assimilate the fundamental laws of electrical engineering, the operation of transformers and motors.

Recommended prior knowledge
Fundamental electrical engineering 2.

Content of the subject:

TP No. 1 No-load, on-load and short-circuit tests of a single-phase transformer

TP No. 2 Load test of a three-phase transformer

TP No. 3 Characteristics of a DC generator
Shunt and separate excitation, self-priming.

TP No. 4 Characteristics of a DC motor
Shunt and series excitation, starting rheostat

TP No. 5 Load characteristics of an asynchronous motor

TP No. 6 Determination of the circular diagram of an asynchronous machine

TP No. 7 Alternator - operation diagram –

Evaluation mode:
Continuous control: 100%.

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

Semester: 4
Teaching unit: UEM 2.2
Subject 3:TP Combinatorial and sequential logic
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

Consolidate the knowledge acquired during the course of the material "Combinatorial 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 material:

The teacher chooses from this list of practical exercises between 4 and 6 practical exercises to carry out and dealing with the two types of logic circuits (combinatorial 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 creation of usual combinatorial logic functions
Example: switching circuits (MUX, DMUX), coding and decoding circuits, etc.

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

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

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

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

TP8: Study and creation of registers

Evaluation mode:

Continuous control: 100%

Bibliographic references:

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

Semester: 4
Teaching unit: UEM 2.2

Subject 4:TP Numerical methods
VHS: 10:30 p.m. (TP: 1:30 a.m.)
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 material:

Chapter 1 :Solving nonlinear equations **3 weeks**
1. Bisection method. 2. Fixed point method, 3. Newton-Raphson method

Chapter 2 :Interpolation and approximation **3 weeks**
1. Newton interpolation, 2. Chebyshev approximation

Chapter 3:Digital integrations **3 weeks**
1. Rectangle method, 2. Trapeze method, 3. Simpson method

Chapter 4:Differential equations **2 weeks**
1. Euler method, 2. Runge-Kutta methods

Chapter 5:Systems of linear equations **4 weeks**
1. Gauss-Jordon method, 2. Crout decomposition and LU factorization, 3. Jacobi method, 4. Gauss-Seidel method

Evaluation mode:

Continuous control: 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: calculation guide, programming graphic representations; compliant with the new MPSI program, Ellipses, 2015.
3. Jean-Philippe Grivet, Applied numerical methods: for the scientist and the engineer,EDP sciences, 2009.

Semester: 4
Teaching unit: UED2.2
Subject 1:Production of electrical energy
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Understand, master and acquire the basic principles of the different modes of producing electrical energy. At the end of this subject,the student must become aware of the energy issue in general, and the impact of electrical energy on socio-economic life, in particular.

Recommended prior knowledge:

Have notions of thermodynamics and fluid mechanics and above all basic knowledge of fundamental electrical engineering (electricity and circuit, electric and magnetic field, power, three-phase regime, alternator, motor, transformer).

Material content:

Chapter 1. General (2 weeks)

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

Chapter 2. Thermal power plants (2 weeks)

Chapter 3. Generators (2 weeks)

Chapter 4. Nuclear power plants (2 weeks)

Chapter 5. Hydraulic power plants (2 weeks)

Chapter 6. Wind energy (2 weeks)

Principle of aerodynamics and types of wind turbines, operating principle, network interfacing, protection and voltage adjustment.

Chapter 7. Solar energy (2 weeks)

Operating principle and technologies, characteristic and optimum operating point.

Chapter 8. Fuel cells (1 week)

Types of fuel cells and principle of operation

Evaluation method:

Review: 100%.

Bibliographic references:

1. Sabonnadière Jean Claude, New energy technologies 1: Renewable energies, Ed. Hermès.
2. Gide Paul, The great book of wind power, Ed. Moniteur.
3. A. Labouret, Photovoltaic Solar Energy, Ed. Dunod.
4. Viollet Pierre Louis, History of hydraulic energy, Ed. Press ENP Chaussée.
5. Weigh Felix A, Solar thermal installations: design and implementation, Ed. Monitor,Dunod/L'Usine nouvelle, 2013.

6. B. Robyns et al, Production of electrical energy from renewable sources (Coll. Sciences and technologies of electrical energy), Lavoisier, 2012.
7. G. Laval, Nuclear fusion: from fundamental research to energy production?, EDP Sciences, 2007.
8. V. Crastan, Power plants and alternative electricity production, Hermès-Lavoisier, 2009.

Semester: 4
Teaching unit: UED2.2
Subject 2:Electrical safety
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

The objective of the material is to inform the future licensee on the nature of electrical accidents, the methods of rescue of electrical accidents and to give him sufficient knowledge to enable him to best dimension the protection devices of the equipment and the personnel involved in industry and other areas of use of this equipment.

Recommended prior knowledge:

Electricity concepts.

Material content:

Chapter 1:Electrical risks (2 weeks)

Definition and purpose of occupational safety, Legend and history of electrical risk, Standards body, Statistics on electrical accidents.

Chapter 2:Nature of electrical accidents and dangers of electric current (3 weeks)

Classification (direct and indirect actions of electric current), Impedance of the human body, Parameters of influence of human current, Pathophysiological effects of the passage of electric current, Electrification without loss of consciousness, Electrification with loss of consciousness (ventricular fibrillation).

Chapter 3:Protective measures (6 weeks)

Introduction, Protection of people, Regulations, Safety measures, Work without voltage, Work near electrical installations, Individual and collective protection, Protection against direct and indirect currents, Safety voltage, Earth connection diagram (SLT), Effects of electric and magnetic fields, Equipment protection, Protective devices (types and reliability of devices), LV, MV and HV indoor installations, LV mobile devices, Checks and controls.

Chapter 4:Safety measures against indirect effects of electric current (2 weeks)

Fires, Harmful materials, Explosions, Noise and vibrations (Definition, standards and techniques for combating noise).

Chapter 5:Relief measures and care (2 weeks)

Attitude to be observed in the event of electrical accidents, First aid, Assisted ventilation (mouth to mouth and Sylvester methods), External cardiac massage, Burn care.

Evaluation mode:

Final exam: 100%.

Bibliographic references:

1-V. Semeneko, General Requirements for Technical Safety in a Company, University of Annaba, 1979.
2- A.Novikov, Work Protection Course Book, University of Annaba, 1983.
3- Edgar Gillon, Electrotechnics Course, Dunod, Paris 1966.
4- Encyclopedia of Industrial Sciences, Quillet, Paris, 1983.
5- LG Hewitson, Guide to the protection of electrical equipment, Dunod, 2007.

Semester:4
Teaching unit: UET2.2
Matter :Expression, information and communication techniques
VHS: 10:30 p.m. (Class: 1h30)
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. It also allows the student to know the techniques, tools and methods used to facilitate communications.

Recommended prior knowledge:

Languages (Arabic; French; English)

Material content:

Chapter 1:Search, analyze and organize information (2 weeks)
Identify and use places, tools and documentary resources, Understand and analyze documents, Create and update documentation.

Chapter 2 :Improve expression ability (2 weeks)
Take into account the Communication situation, Produce a written message, Communicate orally, Produce a visual and audiovisual message, Improve the ability to communicate in a group.

Chapter 3:Develop autonomy, organizational and communication skills within the framework of a project approach (2 weeks)
Position yourself in a project and communication approach, Anticipate action, Implement a project:Presentation of a report of practical work (homework).

Chapter 4: ICT -Definition and Evolution (2 weeks)
Definition, Activities using ICT, Mastery of ICT skills, Evolution of ICT,Information and communication services

Chapter 5: Search, use and retrieval of information. (2weeks)
Search directories (YAHOO, GOOGLE), Search engines, Query and search language, Retrieving and printing an HTML page, Retrieving an image, Downloading a file or software, Reading 'a local HTML file, Playback of a multimedia file saved on the Web.

Chapter 6:ICT rights (2 weeks)
Computer crime, Media law, Electronic communications law, Electronic commerce law, Internet governance, …

Chapter 7: Securing sensitive information, Protection of confidential data and Preservation of nuisances. (3 weeks)
Backup of important data, “Informatics and freedoms” law, Internet dangers, Computer hacking, Machine protection, Protection against viruses, Protection against cyber threats or online threats (Phishing, spam emails, spyware, malware, ransomware, viruses and trojan horses, man-in-the-middle attacks, etc.), Preventing data loss, Spam, Hoaxes, Cryptology, Electronic signature….

Evaluation method:

Final exam: 100%.

Bibliographic references:

(Books and handouts, websites, etc.)

1. Jean-Denis Commeignes, 12 methods of written and oral communications – 4th edition, Michelle Fayet and Dunod 2013.
2. Denis Baril, Sirey, Techniques of written and oral expression, 2008.
3. 3- Matthieu Dubost, Improving your written and oral expression all the keys, Edition Ellipses 2014.
4. Allegrezza Serge and Dubrocard Anne (edited by). Internet Econometrics. Palgrave Macmillan Ltd, 2011. ISBN-10: 0230362923; ISBN-13: 9780230362925
5. Anduiza Eva, Jensen J. Michael and Jorba Laja (edited by). Digital Media and Political Engagement Worldwide. Cambridge UniversityPress - MUA, 2012. ISBN-10: 1107668492; ISBN-13: 9781107668492
6. Baron GL, and Bruillard E. Computer science and its users in education. Paris, PUF, 1996. ISBN-10: 2130474926; ISBN-13: 978-2130474920
7. OnlineChantepie P. and Le Diberder A. Digital revolution and cultural industries. Landmarks. Paris, La Découverte, 2010. ISBN-10: 2707165050; ISBN-13: 978-2707165053
8. Dawn Medlin B. Integrations of Technology Utilization and Social Dynamics in Organizations. Information Science Reference (Isr), 2012. ISBN-10: 1-4666-1948-1; ISBN-13: 978-1-4666-1948-7
9. Devauchelle B. How digital technology is transforming places of knowledge. FYP Editions, 2012. ISBN-10: 2916571612; ISBN-13: 978-2916571614
10. GreenfieldDavid. "The Addictive Properties of Internet Usage." In Internet Addiction, 133?153. John Wiley & Sons, Inc., 2007. ISBN: 9780470551165.http://dx.doi.org/10.1002/9781118013991.ch8.
11. Kurihara Yutaka and [Al.]. Information technology and economic development. Information Science Reference (Isr), 2007. ISBN 10: 1599045818; ISBN 13: 9781599045818
12. Paquelin D. The appropriation of digital training devices. From prescription to use. Paris, L'Harmattan, 2009. ISBN-10: 2296085563; ISBN-13: 978-2296085565
13. Tansey Stephen D. Business, information technology and society. Routledge Ltd, 2002. ISBN-10: 0415192137; ISBN-13: 978-0415192132

Semester: 5
Teaching unit: UEF 3.1.1
Subject 1: Electrical Networks
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:
Provide an overview of the management and sizing of the electrical energy network (transport and distribution).

Recommended prior knowledge:
Basic course in fundamental electrical engineering (electricity and circuit, electric and magnetic field, power, three-phase regime, alternator, motor, transformer).

Material content:

Chapter I: General information on electrical networks (1 week)
- Organization of the electricity network
- Power stations
- Electrical substations (power transformers, measurement transformers (current and voltage), circuit breakers, disconnectors, other substation equipment, etc.)
- Other network elements (supports, conductor cables, overhead lines, underground lines, ground cables, busbars, insulators); Dispatch center.

Chapter II: Modes of transport, distribution and distribution of electrical energy (2 weeks)
- Description of networkselectrical (structure of electrical networks, voltage level);
- Topologyelectrical networks (HV/MV source stations, MV networks, MV/LV stations, LV networks).

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

Chapter IV: Transformers and relative unit system (2 weeks)
- Recalls (single-phase and three-phase transformers, modelization anddetermination of parametersof the transformer, coupling of transformers (different modes, cchoice of coupling));
- Parallel connection of three-phase transformers (interest, conditions, hourly index);
- Main types of transformers (current measurement,voltage measurement, on-load regulator, phase shifter,with three windings andautotransformer);
- Relative unit system (basic quantities (power, voltage, impedance), choice of base,Basis change).

Chapter V: Calculation of short-circuit currents (5 weeks)
- Calculation of short-circuit currents (causes, consequences, different types,concept of symmetrical and asymmetrical short circuit,…);

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

References:

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

[2] **John J. Grainger, William D. Stevenson, Jr.**"Power system analysis", North Carolina State University, 1994.

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

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

[5] Jean-Pierre Muratet, "economic and planning elements for electricity transmission and distribution networks", ALSTOM, 1998.

[6] Serge Pichot, "HT transmission lines" FCI SAAE Transmission, 1998.

[7] Daniel. Noel, "MT/BT stations", ALSTOM, 1998.

[8] Industrial electrical network design guide T&D, "Electrical network architecture"; Schneider electric, 6 883 427/A.

[9] LV electrical network design guide, "Transformer, definitions and characteristic parameters"; Schneider electric, B92.

[10] "The GRTE organization and missions", 10th National Conference on High Voltage CNHT16, May 2016.

[11] April Charles, "Construction of high voltage overhead lines",Paris: Editions Eyrolles, 1974

[12] Souad Chebbi, "Faults in electrical networks", educational support, Virtual University of Tunis.

[13] Electrotechnics second edition, International Polytechnic Presses, 1999.

[14] JC Gianduzzo: Courses and tutorials in electrical engineering, handouts of courses and tutorials for the EEA License from the University of Bordeaux 1.

[15] L. Lasne: Electrical engineering for energy distribution, Course handout from the University of Bordeaux 1, 2004.

[16] T. Wildi: Electrotechnics Third edition, Presses de l'Université de Laval, 2000.

[17]N. HADJSAID, JC SABONNADIERE, 'Electric Lines and Networks 1: Electric power lines', edition:HERMES - LAVOISIER, 2007;

[18]B. DE METZ-NOBLAT, 'Analysis of three-phase networks in disturbed conditions using symmetrical components', Schneider technical notebook N°: 18, 2002;

Semester: 5
Teaching unit: UEF 3.1.1
Subject 2: Power electronics
VHS: 45h00 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge

Fundamental electronics1, Fundamental electrical engineering1.

Content of the material:

The number of weeks displayed are indicated for information purposes only. It is obvious that the course manager is not required to strictly respect this dimensioning or the arrangement of the chapters.

Chapter 1. Introduction to power electronics 3weeks

Introduction to power electronics, its role in electrical energy conversion systems.Introduction to static converters.Classification of static converters (according to switching mode, depending on conversion mode). Non-sinusoidal periodic quantities (rms values, averages, form factor, ripple rate).

Chapter 2. Alternating current – direct current converters 3weeks

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

Chapter 3. AC-AC converters 3weeks

Power elements (triacs with a quick reminder of the diodes and thyristors),Single-phase dimmer, with R, RL load. Principle of the single-phase cycloconverter

Chapter 4. DC-DC converters 3weeks

Power elements (GTO thyristor, bipolar transistor, MOSFET transistor, IGBT transistor),Chopper and booster chopper, withload R, RL and RLE.

Chapter 5. Direct current - alternating current converters 3weeks

Single-phase inverter, half-bridge and bridge mountingwith R and RL load.

Evaluation mode:

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

Bibliographic references:

1. L. Lasne, “Power electronics: Courses, case studies and corrected exercises”, Dunod, 2011.
2. P. Agati et al. “Cheat sheet: Electricity-Electronics of control and power-Electro-technical”, Dunod, 2006.
3. J. Laroche, “Power electronics – Converters: Courses and corrected exercises”, Dunod, 2005.
4. G. Séguier et al. “Power electronics: Courses and corrected exercises”, 8th edition; Dunod, 2004.
5. D. Jacob, “Power electronics - Operating principle, sizing”, Ellipses Marketing, 2008.
6. G. Séguier, “Power electronics, basic functions and their main applications”, Tech et Doc.

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

Semester: 5
Teaching unit: UEF 3.1.2
Subject 1:Servo Systems
VHS: 45h00 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

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

Recommended prior knowledge:
Basic mathematics (Algebra, Integral and differential calculus, Analysis, complexes, etc.). Fundamental notions of signal processing, basic electronics (linear circuits).

Material content:

Chapter 1.Introduction to servo systems (2 weeks)
History of automatic control systems, Terminology and definition, Systems concept, Dynamic behavior, Static behavior, Static systems, Dynamic systems, Linear systems, Introductory examples, Open loop systems, Closed loop systems, Main elements of a control chain servo, Reasoning of a servo, Performance of servo systems.

Chapter 2.Systems modeling (4 weeks)
Representation of systems by their differential equations, Laplace transform, From the differential equation to the transfer function, Functional blocks and subsystems, Simplification rules,System state representation, Correspondence between state representation and transfer function,Calculation of transfer functions of looped systems.

Chapter 3.Answerstemporal systems of linear systems (3 weeks)
Definition of the response of a system, Transient regime, Permanent regime, Notions of stability, speed and static precision, Impulse response (1st and 2nd order), Temporal characteristics, Index response (1st and 2nd order), Identification of first systems and second order from the temporal response, Higher order systems, Influence of poles and zeros on the response of a system.

Chapter 4.Frequency responses of linear systems (3 weeks)
Definition, Bode and Nyquist diagram, Frequency characteristics of basic dynamic systems (1st and 2nd order), Phase and gain margins.

Chapter 5.Stability and precision of servo systems (3 weeks)
Definition, Stability conditions,Routh-Herwitz algebraic criterion, Backhand criteria in Nyquist andBode, Margins of stability,Accuracy of controlled systems, Static precision, Calculation of the static deviation, Dynamic precision, Characterization of the transient regime.

Evaluation method:
Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. EK Boukas, Enslaved systems, Editions de l'École Polytechnique de Montréal, 1995.
2. P. Clerc. Continuous automatic, sampled: IUT Electrical Engineering-Industrial Computer Science, BTS Electronics-Mechanics-Computer Science, Editions Masson (198p), 1997.
3. Ph. de Larminat, Automatic, Editions Hermes 2000.
4. P. Codron and S. Leballois, Automatic: continuous linear systems, Editons Dunod 1998.
5. Y. Granjon, Automatic: Linear, nonlinear, continuous-time, discrete-time systems, state representation, Editions Dunod 2001.
6. K. Ogata, Modern control engineering, Fourth edition, Prentice Hall International Editions 2001.

7. B. Pradin, Course of Automatics. INSA Toulouse, 3rd year GII specialty.
8. M. Rivoire and J.-L. Ferrier, Cours d'Automatique, volume 2: servocontrol, regulation, analog control, Editions Eyrolles 1996.
9. Y. Thomas, Signals and linear systems: corrected exercises, Editions Masson 1993.
10. Y.Thomas. Signals and linear systems, Editions Masson 1994.

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

Teaching objectives:
Deepen and consolidate notions of electromagnetism. Understand the physical and mathematical tools to understand Maxwell's equations as well as wave propagation.

Recommended prior knowledge:
Vector calculation, notions of Gradient, Divergence and Rotational – Concept of electrostatics and magnetostatics.

Material content:

Chapter 0: Vector Concepts: (1 week)

Physical definition of gradient, divergence and rotational, Vector and pseudo-vector, Vector operators, Stocks and Ostrogradski theorem, concept of solid angle.

Chapter 1: Electrostatics: (3 weeks)

Maxwell's equations in electrostatics, Relation of dielectric media, Distribution of electric charges, Force, Considerations of symmetries, Gauss's theorem, Electric flux, Electric scalar potential, Crossing and boundary conditions, Poisson and Laplace equations in electrostatics, Law Coulomb, Electrostatic energy, Capacitance, Electrostatic dipole.

Chapter 2. Magnetostatics: (3 weeks)

Maxwell's equations in Magnetostatics, Relation of magnetic media, Distribution of electric currents, considerations of symmetries, Ampère's theorem, Magnetic flux, Magnetic vector potential, Transit and boundary conditions, Poisson and Laplace equations in magnetostatics, Law of Biot and Savard, Laplace force, Hall effect, Legal definition of the Ampere, Magnetostatic energy, Inductance and reluctance, Magnetic dipole.

Chapter 3. Variable regime: (3 weeks)

Maxwell's equations in any variable regime, Maxwell-Faraday law (Faraday's law and Lenz's law) and Lorentz gauge, Equation of propagation of electric and magnetic fields, Equation of propagation of electric scalar and magnetic vector potentials, Passage conditions and limits, Resolution of propagation equations (delayed potentials), Electromagnetic energy and Poynting vector.

Chapter 4. Slowly variable speed – Electromagnetic induction: (3 weeks)

Approximation of quasi-stationary regimes "ARQS", Conduction and displacement current, and Maxwell-Ampère equation, Conservation and relaxation of the electric charge in conductors, Local Ohm's law, Magnetodynamic equation, Coupled electric circuits, Induction of Neumann, Lorentz induction, Laplace action, Magnetic energy and coenergy.

Chapter 5. Rapidly variable regime – Wave propagation: (2 weeks)

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

Evaluation method:
Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. Rosnel, “Elements of electromagnetic propagation, fundamental physics”, Mc GRAW-HILL, 2002.
2. Garing, "Electromagnetic waves in dielectric media, Exercises and corrected problems", 1998.
3. Paul Lorrain, Dale Corson, and François Lorrain, "Electromagnetic Phenomena: Courses, exercises and solved problems", 2002.
4. Louis de Broglie, "Electromagnetic Waves and Photons", 1968.
5. Garing, "Electromagnetic waves in vacuum and conductive media: Exercises and corrected problems", 1998.
6. Michel Hulin, "Nicole Hulin, and Denise Perrin, Maxwell's equations: electromagnetic waves. Courses, exercises and solved problems", 1998.

Semester: 5
Teaching unit: UEM 3.1
Subject 1: Diagrams and electrical equipment
VHS: 37h30 (Class: 1h30, TP: 1h00)
Credits: 3
Coefficient: 2

Teaching objectives:
Learn the different types of protection and control equipment for electrical installations as well as the creation of an electrical installation.

Recommended prior knowledge:
Concepts of fundamental electricity, electrostatics and basic magnetostatics.

Material content:

ChapterI: Electrical equipment

- Switches (definition, role and characteristics)
- Switches (definition, role and characteristics)
- The disconnector (definition, role and characteristic)
- The contactor (definition, role and characteristic)
- Fuses (role and operation, types, equations).
- Thermal relay (definition, role, type and characteristics).
- Electromagnetic relay (definition, role, type and characteristics).
- Circuit breakers (definition, role, types and characteristics).
- Active and passive sensors: symbols, roles and uses

Chapter II: Development of electrical diagrams

- Standardized symbols for electrical equipment.
- Classification of diagrams according to the mode of representation.
- Conventions and standardization.
- Rules and standards for drawing up an electrical diagram

Chapter III. Lighting circuits

III.1. Single ignition assembly
III.2.Dual ignition assembly
III.3. Back and forth assembly
III.4.Ignition by remote control switch
III.5. Timer ignition
III.5.1. Principle of a timer connected in 4 wires
III.5.2. Principle of a timer connected in 3 wires

Chapter IV. Three modes of controlling an electric motor

IV.1. Direct start with only one direction of rotation
IV.2. Direct motor start with double direction of rotation
IV.3. Star triangle start

Practical work
TP1: The main fixtures for lighting:

Socket mounting, single ignition mounting, double ignition mounting, two-way mounting, mounting with remote control switch, mounting with timer
TP2: Manual control of one contactor and two contactors:
By switch, by push button, remotely by two impulse buttons, remotely by several push buttons.
TP3: Starting a three-phase asynchronous cage motor with one direction of travel
TP4: Starting a two-way asynchronous motor
TP5: Star/delta starting of an asynchronous motor

Evaluation method:

Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. Schneider technical specifications.
2. Technical specifications The big one.
3http://www.yesss-fr.com/tech/symboles-electriques.php
4http://www.repereelec.fr/dm2sm.htm
5. “Memento of electrical diagrams”, Thierry Gallauziaux, David Fedullo
Edition Eyrolles, collection: DIY notebooks; 2009 (2nd edition)
6. “The Electrical Diagram”, Hubert Largeaud, Edition Eyrolles – 1991 (-3rd Edition)
7. Christophe Prévé-, “Protection of electrical networks”, Hermès, Paris, 1998.
8. SH Horowitz, AG Phadke, "Power System Relaying", second edition, John Wiley & Sons, 1995.
9. L. Féchant, “LV electrical equipment, distribution devices”, Engineering Techniques, treatise Electrical Engineering, D 4 865.

Semester: 5
Teaching unit: UEM 3.1
Subject 2: Practical Electrical Networks
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

See and understand the behavior of a power line, voltage drop, voltage regulation and reactive energy compensation. Establish the power flow and calculate the voltage drop and understand the energy transit between two stations.

Recommended prior knowledge:

Basic notions of electrical engineering.

Material content:

TP 1: Study of the efficiency of a line and improvement of the power factor.

TP 2: Voltage regulation by the method of reactive energy compensation using capacitors.

TP 3: Direct current model: Power distribution and calculation of voltage drops.

TP 4: Parallel operation of transformers.

Evaluation method:

Continuous control: 100%.

Bibliographic references:

1. Sabonnadière, Jean-Claude, "Electric lines and networks", Vol. 1, Lineselectric energy, 2007.
2. Sabonnadière, Jean-Claude, "Electrical lines and networks", Vol. 2, Methods for analyzing electrical networks, 2007.
3. Lasne Luc, "Electrical engineering exercises and problems: basic notions, networks and electrical machines", 2011.
4. J. Grainger, "Power system analysis", McGraw Hill, 2003
5. W.D. Stevenson, "Elements of Power System Analysis", McGraw Hill, 1982.

Semester: 5
Teaching unit: UEM 3.1
Subject 3: Power electronics TP
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge:

Basic electrical and electronic circuits.

Material content:

TP 1: Switching component (IGBT, MOS).

TP 2: Single-phase and three-phase uncontrolled rectifier (R, L load).

TP 3: Single-phase and three-phase controlled rectifier (R, L load).

TP 4: Chopper.

TP 5: Single-phase inverter.

TP6: Single-phase dimmer (Load R, L).

TP7: Three-phase dimmer.

Evaluation method:

Continuous control: 100%.

Bibliographic references:

Semester: 5
Teaching unit: UEM 3.1
Subject 4: TP Controlled Systems/ TP Sensors
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

Complete, consolidate and verify the knowledge already acquired in the controlled systems and sensors and metrology courses.

Recommended prior knowledge:

Systems aserved.

Material content:

TP 1: Study of systems behavior 1st; 2nd and 3rd order
Analog and computer simulation, Measure the parameters which characterize the different responses: rise time; response time; 1st maximum overshoot, peak time and accuracy, Observe the response of an unstable system.

TP 2: Frequency responses and system identification
Determination of the frequency characteristics of a servo, with the aim of identifying the transfer function of a system, Application on a motor.

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

TP 4: Enslavementof the speed of a DC motor
The operation of the elements and the controlled system in open and closed loop, The influence of gain on the stability of the system, The influence of gain and load on the static error of the system, The influence of negative feedback of current on the dynamic behavior of the system.

TP 5:Stability and precision of servo systems
Analog and computer simulation.Study the stability and precision of servo systems by modifying thetheir parameters (Resistance, capacitance, inductance, etc.) and their architectures (series, parallel). Application of cRouth-Hurwitz algebraic criterion,criteria in the Nyquist and Bode plans. Mmeasurethe Stability margin, calculate the static and dynamic errors as well as the precision for different types of systems (presence of integrators, derivatives, etc.) and for different types of input (step, ramp, pulse).

TP Sensors:
Photometric sensors, Sensors of mechanical quantities: deformation, force; position, rotation speed, temperature sensors.

Evaluation method:

Continuous control: 100%.

Bibliographic references:

Semester: 5
Teaching unit: UED 3.1
Subject 1: Sensors and Metrology
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Know the different constituent elements 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.

Material content:

Chapter 1.General **(2 weeks)**

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

Chapter 2.Temperature sensors **(2 weeks)**

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

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

Photometric quantities, Photoresistor, photodiode, phototransistor.

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

Resistive, inductive, capacitive, digital, proximity.

Chapter 5.Deformation, force and pressure sensors **(2 weeks)**

Chapter 6.Rotation speed sensors **(2 weeks)**

Analog, digital tachometer.

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

Chapter 8.Data acquisition chain(1 week)

Evaluation method:

Exam: 100%.

Bibliographic references:

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

Semester: 5
Teaching unit: UED 3.1
Subject 2: Design of electrical systems
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Be able to calculate and size an electrical machine according to the requirements of precise specifications.

Recommended prior knowledge:

Constitutive elements and operating principles of electrical machines.

Material content:

Chapter 1– Reminders **(1 week)**
Reminder on materials for electrical machines: Insulators; Drivers; Magnetic

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

Chapter 3.DC electrical machines **(3 weeks)**
Reminder on the operating principle and their uses
Machine sizing, choice of winding, nameplates.

Chapter 4.Asynchronous machines **(3 weeks)**
Reminder on the operating principle and their uses
Sizing an asynchronous machine, Choice of winding, Choice and selection of asynchronous motors.

Chapter 5.Synchronous machines **(3 weeks)**
Reminder on the operating principle and their uses
Sizing a synchronous machine, Choice of winding.

Bibliographic references:

1. http://elearning.vtu.ac.in/06EE63.html
2. *Transformers design, A. Dymkov, Mir Bublishers, Moscow, 1975*
3. *Calculationof themachineselectric. Volume I and Volume II / M. Liwschitz Dunod / cop. 1967-1970*
4. *Design of three-phase asynchronous motors, BOUCHARD & OLIVIER, Ecole ploytechnique de Montréal, 1997*
5. *Design of Rotating Electrical Machines, 2nd Edition, JuhaPyrhonen, TapaniJokinen, Valeria Hrabovcova, ISBN: 978-1-118-70165-2, Sep 2013, 616 pages*
6. *Industrial theory of electricity and electrical machines, by A. Verdurand,...1919*
7. *The construction of electrical machines, Julien Dalemont, Librairie polytechnique, 1907 - 138 pages*

Semester: 5
Teaching unit: UET 3.1
Subject 1: Simulation software
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

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

Recommended prior knowledge:
Programming concepts, Matlab concepts.

Material content:

Chapter 1: Getting started with MATLAB(02 weeks)

1.1 - Introduction
1.2 - MATLAB environment
1.3 - Starting MATLAB
Command window, Defined variables window (the workspace),Working Directory Window, Command History Window
1.4 - Presentation and general information
Getting help, Getting started, The workspace, Syntax of a line of instructions, Managing files in the working directory, Arithmetic operations, Operations and functions involving scalars, Special variables and constants, Format numbers and calculation accuracy, Order history

Chapter 2: Data Types and Variables(02 weeks)

2.1 - Data types
2.2 - The variables
Complex numbers,Boolean variables,Character strings,Vectors,Matrices,Polynomials.

Chapter 3: Graphs(01 week)

3.1 - Managing graphic windows
3.2 - 2D graphical representation
Charts in Cartesian coordinates,Improve the readability of a figure,Polar coordinate graphs,The diagrams.
3.3 - 3D graphics
3D curves,Surfaces

Chapter 4: Programming in MATLAB(02 weeks)

4.1 - Arithmetic, logical operators and special characters
4.2 - M-Files
4.3 - Scripts and functions
(Scripts,Functions)
4.4 - Control Instructions
(FOR loop, WHILE loop, Conditioned IF statement)

Chapter 5: Getting started with SIMULINK(03 weeks)

5.1- SIMULINK libraries
Libraries Sources,Sinks,Continuous,Math Operations,Commonly Used Blocks,Signal Routing,Logic and Bit Operations,User-Defined Functions,Ports & Subsystems,…….
5.2- Quick start
5.3 - Masks and subsystems
5.2.1 - Subsystems

5.3.2 - Hiding subsystems
Subsystem masking,Using Callbacks
5.4- Study of some simulation examples

Chapter6: Power System Blockset (PSB)(02 weeks)

6.1 - Power System Blockset Overview
6.2 - Study of a simulation example

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

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

Evaluation method:

Exam: 100%.

Bibliographic references:

1. A. Lanton, "Simulation methods and tools", Edition, Hermès, 2000.
2. Matlab online documentation

Semester: 6
Teaching unit: UEF 3.2.1
Subject 1: Control of electrical machines
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

Understand, analyze and model the machine-converter assembly, carry out the wiring of the control and power circuits of electrical machines.

Recommended prior knowledge:

Electrical machines, static converter, servo systems, open loop and closed loop regulation.

Material content:

Chapter 1.Introduction to controlling electrical machines **(1 week)**

Chapter 2. Control of static converters **(1 Semaine)**
MLI technique

Chapter 3.Speed adjustment of DC machines **(5 weeks)**
Reminders ondirect current machines (Operating principle, Equivalent electrical diagram, the different types of direct current machines), Electromechanical and mechanical characteristics of direct current machines, Mechanical characteristics of driven loads, Operating point of a motor group, driven load (Stability, Starting, Electric braking).
Methods for adjusting the speed of a shunt motor(rheostatic adjustment, Flow adjustment, Voltage adjustment).

Chapter 4.Speed variation of asynchronous motors **(4 weeks)**
Reminders onasynchronous machines, Reminders onpower electronics converters, Association of asynchronous machines (converters), Speed adjustment of asynchronous motors (adjustment by action on the supply voltage, adjustment by action on the rotor resistance, adjustment by hypo-synchronous cascade, adjustment by variation of power frequency).

Chapter 5.Speed adjustment and self-control of synchronous motors **(4Sweeks)**
Reminders onsynchronous machines, Association of synchronous machines (converters), Speed adjustment of synchronous motors (principle of self-control of synchronous motors, speed adjustment of the self-controlled synchronous machine powered by a current switch, speed adjustment of the self-controlled synchronous machine powered by a PWM voltage inverter).

Evaluation method:

Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. R. Abdessemed, "Modeling and simulation of electrical machines",Ellipses,Collection, 2011.
2. Mr Juferthe, “Electric Drives: Design Methodology”,Hermes, Lavoisier,2010.
3. G. Guihéneuf, "Electric motors explained to electronic engineers, Achievements: starting, speed variation, braking",Publitronic, Elektor,2014.
4. P. Mayé, "Industrial electric motors, License, Master, engineering schools",Dunod,Collection:Higher sciences,2011.
5. S. Smigel,"Modeling and control of three-phase motors. Vector control of synchronous motors", 2000.
6. J. Bonal, G. Séguier, “Electric drives at variable speeds”. Flight. 2, Vol. 3

Semester: 6
Teaching unit: UEF 3.2.1
Subject 2: Industrial regulation
VHS: 45h00 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Master the principle and structure of regulation loops. VSchoose the appropriate regulator for an industrial process in order to have the required performance (stability, precision).

Recommended prior knowledge:

Knowledge of continuous linear servos and general electricity.

Material content:

Chapter 1.Introduction to industrial regulation (2 weeks)

Concepts of industrial process,Organs of a regulation loop (industrial process, actuators, sensors, regulators, signal conditioner,setpoint, measurement, disturbance, characteristic quantities, regulating quantities, regulated quantities, disturbing quantities), Diagram of a regulated system, Constituent elements of a regulation loop, symbols, functional diagrams and loops, performance criteria for regulation.

Chapter 2.On-off regulator (2 weeks)

On-off regulator, On-off regulator with threshold, On-off regulator with hysteresis, On-off regulator with threshold and hysteresis.

Chapter 3. Identification of open and closed loop systems (2 weeks)

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

Chapter 4.Standard regulators: P, PI, PD, PID (2 weeks)

Characteristics, Structures of PID regulators (parallel, series, mixed), Electronic and pneumatic achievements.

Chapter 5.Choice and sizing of regulators (4 weeks)

Selection criteria, Sizing methods (flat criterion, symmetrical criterion, Ziegler Nichols method, etc.), Adjustment of Regulators by imposing a tracking model.

Chapter 6.Industrial applications (3 weeks)

Regulations oftemperature, flow, pressure, level.

Evaluation method:

Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. E. Dieulesaint, D. Royer, “Applied automation”, 2001.
2. P. De Larminat, “Automatic: Control of linear systems. Hermes 1993.
3. KJ Astrom, T. Hagglund, "PID Controllers: Theory, Design and Tuning", Instrument Society of America, Research Triangle Park, NC, 1995.
4. A. Datta, MT Ho, SP Bhattacharyya, "Structure and Synthesis of PID Controllers", Springer-Verlag, London, 2000.
5. Jean-Marie Flaus, “Industrial regulation”, Editions, Hermes, 1995.

6. P. Borne, “Analysis and regulation of industrial processes volume 1: Continuous regulation”. Technip Editions.
7. T. Hans, P. Guyenot, “Regulation and enslavement” Editions, Eyrolles.
8. R.Longchamp,"Numerical control of dynamic systems automation course", Presses Polytechniques et Universitaires Romandes, 2006.
9. http://www.technologuepro.com/cours-genie-electrique/cours-6-regulation-industrial/.

Semester: 6
Teaching unit: UEF 3.2.2
Subject 1: Industrial automation
VHS: 45h00 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Master the graphic representation tools ofautomated systems (Grafcet),Install and maintain componentsindustrial automation,Carry out programming and configuration of programmable controllers.

Recommended prior knowledge:

Basic knowledge of digital electronics, Computer programming languages.

Material content:

Chapter 1.Introduction to Automated Systems **(3 weeks)**

Overall function of a system, Automation and structure of automated systems, Pre-actuators (Contactors, Triac, etc.), Actuators (cylinders, Motors, etc.), sensors, Classification of automated systems, Specification of the levels of the specifications, Tools for representing functional specifications.

Chapter 2.The Grafcet **(3 weeks)**

Definition and notions ofbases, Rules for establishing GRAFCET,TransitionsAndoriented connections,Evolution rules,Sequence selectionAndsimultaneous sequences,Organization of levels of representation, Materialization of a GRAFCET, Practical examples.

Chapter 3.Programmable robot **(4 weeks)**

Internal structure and description of the elements of an API,Choice of processing unit, Choice of an industrial programmable controller,Input-output interfaces,Toolsgraphic and textual programming,Implementation of an industrial programmable controller, Principles of PLC networks.

Chapter 4.On and Off Modes Study Guide (GEMMA) **(3 weeks)**

Concept and structuring of GEMMA, Operating, shutdown and maintenance proceduresfailure procedures, Practical use of GEMMA and applications.

Chapter 5.Applications in Electrical Engineering **(2 weeks)**

Automation of starting of DC motors, Automatic start-stop of asynchronous and synchronous motors, Automation of the p processrotectionelectromagnetic melectric motors, Automation of motor protection by thermal relay.

Evaluation method:

Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. Jean-Claude Humblot, “Industrial programmable logic controllers”, Hermès, 1993.
2. Sandre Serge, Jacquar Patrick, “Industrial programmable logic controllers”, Lavoisier, 1993.
3. P. Le Brun, “Programmable automatons”, 1999.
4. Jean-Yves Fabert, “Automatisms and Automatics”, Ellipses, 2005.
5. William Bolton, “Industrial Programmable Automata”, Dunod, 2009.
6. Khushdeep Goyal and Deepak Bhandari, "Industrial Automation and Robotics", Katson Books, 2008.

7. Gérard Boujat, Patrick Anaya, "Industrial automation in 20 files, Dunod, 2013.
8. Simon Moreno, Edmond Peulot, "The Grafcet: Design-Implementation in industrial programmable logic controllers", Edition Casteilla 2009.
9. G. Michel, “PLCs: Architecture and applications of industrial programmable logic controllers”, Edition Dunod, 1988.
10. William Bolton, “Industrial Programmable Automates”, Edition Dunod, 2010.
11. Frederic P. Miller, Agnes F. Vandome, John McBrewster, "Industrial Programmable Automata: Computer Programming, Automation, Industry, Programming (computer science), Switch, Automatician", Edition Alphascript Publishing, 2010.

Semester: 6
Teaching unit: UEF 3.2.2
Subject 2: Materials and introduction to High Voltage
VHS: 45h00 (Class: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

Choose the appropriate material in relation to its operating conditions and its environment.

Recommended prior knowledge:

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

Material content:

Part I-Mymaterialselectrotechnical

Chapter 1.Conductive materials (1 week)
Basic concepts, Classification of conductors and properties according to their use.

Chapter 2.Magnetic materials (3 weeks)
Magnetism on the microscopic and macroscopic scale, Classification of magnetic materials, Magnetization mechanisms and technical characteristics of magnetization, Soft ferromagnetic materials, Areas of use, Hard ferromagnetic materials, Characteristics and areas of application of magnets permanent, Concepts of energy in magnetic materials, Magnetic losses, measurement of losses in fixed field and rotating field.

Chapter 3.Dielectric materials (2 weeks)
Polarization phenomena, Resistivity, Dielectric rigidity and Dielectric losses, Physico-mechanical properties, Electro-insulating materials.

Chapter 4. MaterialsSemiconductors: (1 week)
General information on semiconductors and their applications.

Chapter 5. MaterialsSuperconductors (1 week)
General information on Superconductors and their applications.

Part II-Introduction to High Voltage

Chapter 1. General information on high voltage (1 week)
Voltage ranges, Utility of high voltage, Choice of HV equipment, technological and industrial applications of high voltage

Chapter 2.General information on constraints due to HT (2 weeks)
Goals and methodology of HT,Voltage-related constraints, Current-related constraints,Overvoltage and overcurrent protection.

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

Chapter 4: Transient phenomena in High Voltage (2 weeks)
Origins of overvoltages, Lightning phenomenon and the impact on electrical installations, Operating overvoltages, The different protection techniques

Evaluation method:

Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. P. Robert, “Electrical engineering materials”, Dunod.
2. F. Piriou, “Electrical engineering materials”,MGE 2000, Germs.
3. Gérald Roosen, “Semiconductor materials and nitrides for optoelectronics”, Hermès.
4. P. Tixador, “Superconducting materials”, Hermès.
5. M. Aguet, "M. Ianovici, Haute Tension", vol XXII, Edition Georgi, 1982.
6. G. LeRoy, C. Gary, B. Hutzler, J. Hamelin, J. Fontaine, "The dielectric properties of air and very high voltages", Editions Eyrolles, 1984.
7. D. Kind, H. Kärner. "High voltage insulation technology: Textbook for Electrical Engineers",FriedrVieweg&Sohn, 1985.
8. JP Holtzhausen, WL Vosloo, "High Voltage Engineering, Practice and Theory".
9. André Faussurier, Robert Servan, “Materials in electrical engineering”, Dunod Paris, 1971.
10. A. Chabloz, “Materials technology”, Switzerland 1980.

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 global and complementary manner. Concretely put into practice the concepts instilled during the training. Encourage a sense of autonomy and a spirit of initiative in students. Teach him to work in a collaborative setting by arousing intellectual curiosity in him.

Recommended prior knowledge:

The entire Bachelor's program.

Material content:

The theme of the End of Cycle Project must come from a concerted choice between the tutor teacher and a student (or a group of students: pair or even three). The content of the subject must necessarily fit with the objectives of the training and the real skills of the student (Bachelor 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.

Remarks:
During the weeks during which the students are immersed in the purpose of their project and its feasibility (bibliographic research, search for software or hardware necessary for carrying out the project, revision and consolidation of teaching having a direct link with the subject, etc.), the subject manager must take advantage of this face-to-face time to remind students of the essential content of the two subjects.Writing methodology''And ''Presentation methodology''addressed during the first two semesters of the common base.

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

- The detailed presentation of the study theme, emphasizing its interest in its socio-economic environment.
- The means implemented: methodological tools, bibliographical references, contacts with professionals, etc.
- Analysis of the results obtained and their comparison with the initial objectives.
- Criticism of the discrepancies observed 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 be given 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 teacher and an examining teacher who can ask questions and thus evaluate the work accomplished on the plan. technical and that of the presentation.

Evaluation method:

Controlcontinuous: 100%.

Semester: 6
Teaching unit: UEM 3.2
Subject 2: Practical machine control
VHS: 3:00 p.m. (TP: 1:00 a.m.)
Credits: 1
Coefficient: 1

Teaching objectives:

Discover the different types of drives at variable speeds of electrical machines as well as their electromechanical characteristics.

Recommended prior knowledge:

The basic principles of Electrical Engineering and the characteristics of electrical machines.

Material content:

TP1: Starting a DC motor

TP2: Bidirectional rectifier association/DC machine

TP3: Chopper association/DC machine

TP4: Inverter association/AC machine

TP5: Frequency converter association /AC machine

TP6: Study of theControl of a stepper motor

Evaluation method:

Continuous control: 100%.

Bibliographic references:

Course notes on electrical machines, power electronics and control.

Semester: 6
Teaching unit: UEM 3.2
Subject 3: Industrial regulation practical work
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

Manipulate control loops, compare practical and theoretical parameters.

Recommended prior knowledge:

Controlled systems and regulation courses.

Material content:

TP1: Frequency responses and system identification.

TP2: Characteristics of regulators.

TP3: Analog regulation (PID) of fluid level.

TP4: Speed regulation of an MCC motor**.**

TP5: Pressure regulation.

TP6: Rtemperature regulation**.**

Evaluation method:

Continuous control: 100%

Bibliographic references:

Lab brochure, course notes, lab documentation.

Semester: 6
Teaching unit: UEM 3.2
Subject 4: Automation practical work/Materials and HT practical work
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:
Carry out manipulations to enrich knowledge aboutindustrial automation. Pbe able to choose and characterize an unknown material.

Recommended prior knowledge:
Course content.

Material content:

TP: Industrial Automation
TP1: initiation and introduction to Grafcet or other automation language (1 Week)
TP2: Getting started with automation software (e.g. Automation of other software (1 week.
TP3: Convergence and divergence in AND and OR (2 Weeks)
TP4: Time delay (1 Week)
TP5: Counters (1 Week)
TP6: Grafcet of an automatic drilling post (1 Week)
TP7: Grafcet of a bottle filling system (1 Week)
TP8: Grafcet of a direct start of a three-phase motor in 2 directions of rotation (2 Weeks)

TP: Materials and introduction to HT
Measurement of the transverse dielectric rigidity of a gas, solid and liquid, Characterization of the longitudinal dielectric rigidity of an insulation according to its surface condition (clean or polluted), Measurement of the surface, volume and insulation resistance of an insulator, Determination of the relative permittivity, capacitance and dielectric losses of solid and liquid insulation.

Evaluation method:
Continuous control: 100%.

Bibliographic references:
Lecture Notes and Lab Brochures.

Semester: 6
Teaching unit: UED 3.2
Subject 1: Protection of electrical networks
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Become familiar with the different processes and techniques for protecting electrical networks and its elements against different constraints and ensure better protection.

Recommended prior knowledge:

Fundamental notions of electricity, Equivalent diagrams of electrical circuits, Electrical energy networks (constitution, modeling and calculation).

Material content:

Chapter 1. Introduction to protection (4 weeks)

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

Chapter 2: Reminders on symmetrical components and fault currents (3 weeks)

Definition of symmetrical components, Transformation of load impedances into symmetrical components, Symmetrical components of "series" impedances, Equivalent single-phase diagrams of rotating machine sequences, Expression of apparent power in symmetrical components, equivalent diagrams (direct, inverse and homopolar, relationships different types of defects)

Chapter 3. Elements of the protection system (3 weeks)

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

Chapter 4. Protection of network elements (5 weeks)

Protection of alternators and motors, Protection of busbars, Protection of transformers, Protection of lines, distance and differential.

Evaluation method:

Exam: 100%

Bibliographic references:

1. Hadi Saadat, "Power system analysis", Edition 2, 2004.
2. Furan Gonon, "Electric Power distribution system engineering", Edition, 1980.
3. Christophe Prévé, “Protection of electrical networks”, Hermes Paris, 1998.
4. SH Horowitz, AG Phadke, "Power System Relaying", second edition, John Wiley & Sons, 1995.
5. L. Féchant, “LV electrical equipment, distribution devices”, Engineering Techniques, treatise Electrical Engineering, D 4 865.
6. S. Vacquié, A. Lefort, “Physical study of the electric arc, The electric arc and its applications”, Volume 1, ed. of CNR,S 1984.

Semester: 6
Teaching unit: UED 3.2
Subject 2: Industrial maintenance
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

HASensuring the continuity of service of an industrial installation, iidentify the functions and components of electrical and electronic equipment, determine the causes of system failure and repair them.

Recommended prior knowledge:

Statistics, equipment, measurements and instrumentation.

Material content:

Chapter 1.General information on maintenance (4Sweeks)

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

Chapter 2.Organization and management of maintenance (4 weeks)

Structure of workshops specializing in the troubleshooting of electromechanical converters, Organization of maintenance operations, Main stages of troubleshooting technology for electrical machines, Study of the various breakdowns of electrical machines and methods of their detection, Disassembly and reassembly technique, Tests and diagnostics before troubleshooting.

Chapter 3.Troubleshooting different parts of electrical machines (4 weeks)

Troubleshooting the mechanical part, Troubleshooting the electrical part, Calculation and verification of the parameters of the electro-energetic systems, Recalculation of the electro-energy systems on other data from the nameplate, Assembly work and method of testing after troubleshooting.

Chapter 4.General information on computer-assisted maintenance (CAM) (3 weeks)

Evaluation method:

Exam: 100%

Bibliographic references:

1. G. Zwingelstein, “Failure diagnosis”, Hermès, Paris, 1997.
2. “Maintenance based on reliability”, Hermès, Paris, 1997.
3. Jean Henq, “Practice of preventive maintenance”, Dunod, 2000.
4. Raymond Magnan, “Practice of industrial maintenance”, Dunod, 2003.
5. Yves Lavina, “Industrial maintenance, Company function”, 2005.
6. M. François, “Maintenance: method and organization”, Dunod, Paris, 2000.
7. M. François, “Maintenance: method and organization”, Dunod, Paris, 2000.
8. A. Boulenger, C. Pachaud, “Vibration diagnosis in preventive maintenance”, Dunod, Paris, 2000.
9. Jean Henq, “Practice of preventive maintenance”, Dunod, Paris, 2002.
10. R. Cuigent, “Maintenance management”, Dunod, Paris, 2002.
11. Rachid Chaib, “Maintenance and industrial safety in the company”, Dar El Houda, Algiers, 2007.

12. S. Robert, S. Stéphane, “Maintenance: the MAXER method”, Dunod, Paris, 2008.
13. JFD Beaufort, “Use of relays for the protection of installations”, 1972.
14. Michel Pierre Villoz, “Protection and environment”, Technique and engineer, 2006.
15. Nichon Margossian, “Professional risks”, Technique and engineer, 2006.

Semester: 6
Teaching unit: UET 3.2
Subject: Entrepreneurship and business management
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

- Prepare for professional integration at the end of your studies;
- Develop entrepreneurial skills among students;
- Raise awareness among students and familiarize them with the possibilities, challenges, procedures, characteristics, attitudes and skills required by entrepreneurship;
- Prepare students so that one day they can create their own business or, at least, better understand their work in an SME.

Recommended prior knowledge:

No special knowledge, except mastery of the language of instruction.

Targeted skills :

Ability to analyze, synthesize, work in a team, communicate well orally and in writing, be autonomous, plan and meet deadlines, be reactive and proactive. Be made aware of entrepreneurship by presenting an overview of management knowledge useful for creating activities.

Material content:

Chapter 1 – Operational preparation for employment: **(2 weeks)**

Writing the cover letter and developing the CV, Job interview, etc., Documentary research on professions in the sector, Conducting interviews with professionals in the profession and Simulation of job interviews.

Chapter 2 - Entrepreneurship and entrepreneurial spirit: **(2 weeks)**

Getting started, Businesses around you, Entrepreneurial motivation, Knowing how to set goals, Knowing how to take risks

Chapter 3 - The profile of an entrepreneur and the profession of Entrepreneur: **(3 weeks)**

The qualities of an entrepreneur, Knowing how to negotiate, Knowing how to listen, The place of SMEs and VSEs in Algeria, The main success factors when creating a VSE/SME

Chapter 4 – Finding a Good Business Idea: **(2 weeks)**

Creativity and innovation, Recognizing and evaluating business opportunities

Chapter 5–Lancerand Running a Business: **(3 weeks)**

Choosing an appropriate market, Choosing the location of your business, Legal forms of business, Finding help and financing to start a business, Recruiting staff, Choosing your suppliers

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

The Business Model and the Business Plan, Realize your business project with the Business Model Canvas

Evaluation method: Review: 100%

References :

- FayolleAlain, 2017. Entrepreneurship theories and practices, applications for learning to do business. Dunod, 3rd ed.

- LégerJarniou, Catherine, 2013, The entrepreneur's great book. Dunod, 2013.

- PlaneJean-Michel, 2016, Management of organizations theories, concepts, performances. Dunod, 4th ed.

- LégerJarniou, Catherine, 2017, Building your Business Plan. The Entrepreneur's Big Book. Dunod,.

- Sion Michel, 2016, Succeeding in your business Methods, tools and tips plan.Dunod, 4th ed.

- Patrick Koenblit, Carole Nicolas, Hélène Lehongre, Building your professional project, ESF, Editor 2011.

- Lucie Beauchesne, Anne Riberolles, Building your professional project, L'Etudiant 2002.

- ALBAGLI Claude and HENAULT Georges (1996), Business creation in Africa, ed EDICEF/AUPELF, 208 p.

IV- Agreements / Conventions

STANDARD LETTER OF INTENT

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

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

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

The university (or academic center) hereby declares that it co-sponsors the above-mentioned license throughout the license authorization period.

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

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

STANDARD LETTER OF INTENT

(If licensed in collaboration with a user sector company)

(Official company letterhead)

OBJECT : Approval of the project to launch a License training course entitled:

Provided to:

The company hereby declares its willingness to demonstrate its 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 educational programs,
- Participate in seminars organized for this purpose,
- Participate in defense juries,
- Facilitate as much as possible the reception of interns either as part of end-of-study theses or as part of tutored projects.

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

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

SIGNATUREof the legally authorized person:

FUNCTION :

Date :

OFFICIAL STAMP or COMPANY SEAL

V - Opinions and Visas from Administrative and Consultative Bodies

Title of the License: Electrotechnics

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

VI – Opinion and Visa of the Regional Conference

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