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

LOGO

TRAINING OFFER
LMD

ACADEMIC LICENSE

NATIONAL PROGRAM
2021–2022
(2nd update)

Establishment	Faculty / Institute	Department

Domain	Sector	Speciality
Science And Technologies	***Electronic***	***Electronic***

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

عرض تكوين
ل. م. د
ليسانس أكاديمية

برنامج وطني
2021-2022

المؤسسة	الكلية/ المعهد	القسم

الميدان	الفرع	التخصص
علوم و تكنولوجيا	الكترونيك	الكترونيك

Summary

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:

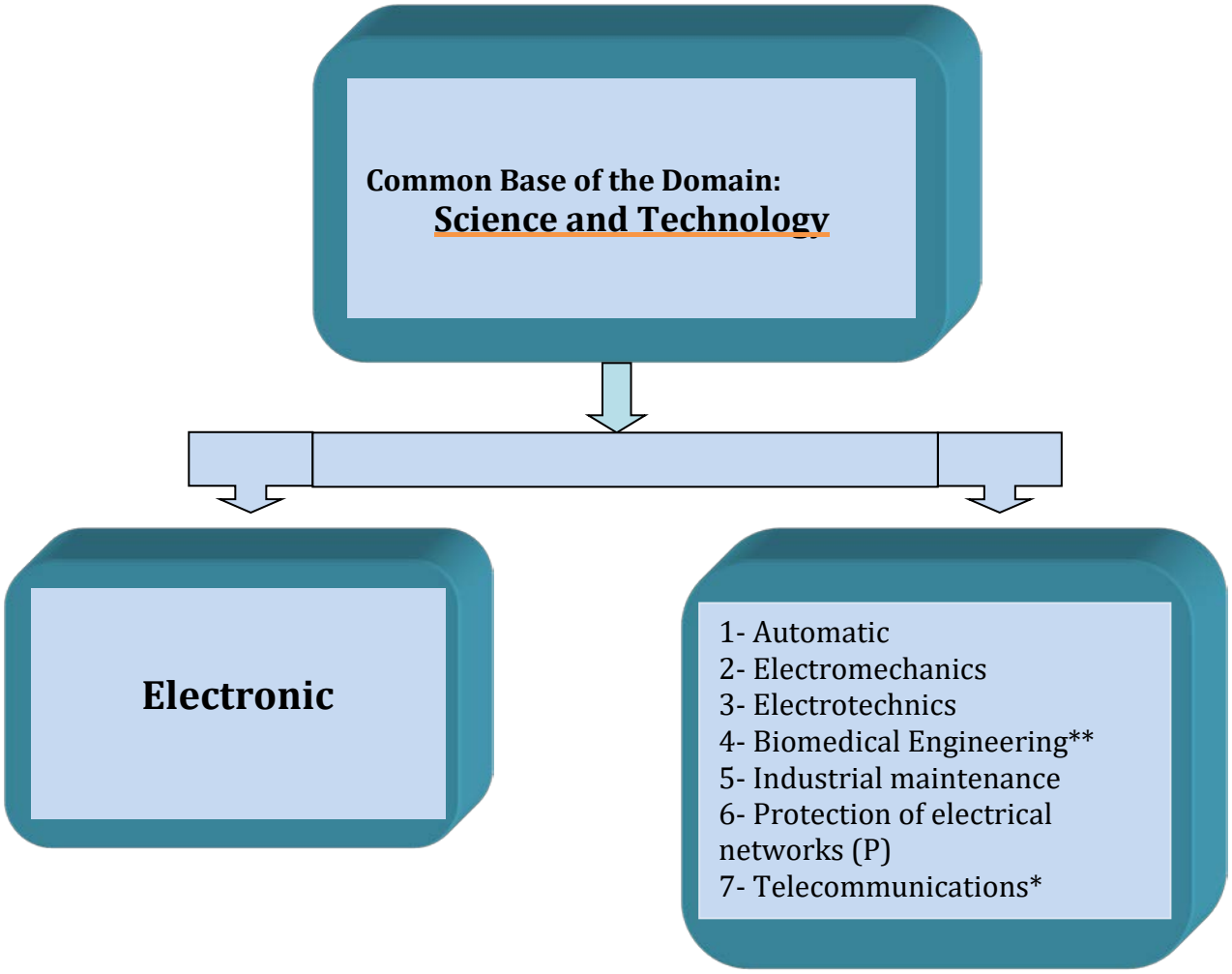
Businesses and other socio-economic partners:

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 license whose supervision is ensured by a simple majority of the teachers involved in this license. Indicate frozen licenses with a double asterisk. Also mark with (P) any professional type license.



B - Training objectives:

Electronics are present in all areas. The almost systematic digitalization of information calls into question traditional areas such as telephony and automation. The success of the Internet, GSM and communication networks is growing and requires significant infrastructure which will only develop in the future.Technological breakthroughs in the manufacturing of cells produced with standard silicon wafers are constantly improving. The level of efficiency of these cells should ultimately make it possible to offer a real alternative to fossil fuels.
Furthermore, highly technological sectors such as aeronautics, automobiles, robotics, modern medicine and space are excessive consumers of electronic products.
It therefore becomes essential to put major resources into this sector in order to develop the field of electronics through scientific research, equipment and training. Investment in the human component is, in our eyes, by far the most fundamental and the guarantor of any process of development of a society.It is for this reason that this training is offered.
This course is intended to be a common crucible without premature specialization and nevertheless leading to a progressive diversification towards any course, existing or future, of Master in electronics in the broadest sense.
This training, whichfalls within the field of Science and Technology,is based on the one hand on fundamental matters(maths, physics, chemistry and computer science up to 40%: 72/180 credits)and on the other hand on matters closely linked to educationelectronicnamely: analog and digital electronics, servo control, power electronics, signal processing, etc. (87/180 credits eitheralmost 50%). On another note,the pedagogy in this training is resolutely oriented towards experience. To this end, a large part was intended for practical work sessions (25% of the total hourly volume): almost all of the specialty subjects are supported by practical work sessions. At the same time, students are trained in collective work in order to promote autonomy, a sense of responsibility and a spirit of initiative thanks to training including aProfessional Project and Business Management and aEnd of Cycle Project.

C – Targeted profiles and skills:

This Degree in Electronics is academic in nature. It aims firstly to:

- ✓ Train students capable of pursuing studies in all types of existing Masters in electronics, or even later in doctorate,
- ✓ Acquire a diploma recognized by the socio-economic environment (regional and national) and adapt to the current and future needs of our society.

Indeed, this training is a springboard for a very wide range of electronics professions (space conquest, automobiles, radio, television, telephony, medicine, robotics, imaging, industrial computing, embedded systems, etc.). Training in this field therefore offers numerous professional opportunities in a wide variety of industries.

D – Regional and national employability potential:

At the end of this training, the graduate can not only pursue higher studies (Master's, Doctorate) but also be able to occupy a versatile executive job in electronics, called upon to meet both national and regional needs:
(Nationally)

- Electricity production and distribution company;
- Telecommunications sector (telephone operators);
- SMEs in the Electronics sector, …

(Regionally)

- Industrial steel companies;

- Chemical Engineering Companies;
- SMEs in microcomputing and the agri-food industry.

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	**Speciality**
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 Process Engineering 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 of 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 him to build his professional identity according to his aspirations, his abilities and his acquired knowledge or to build his 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	Materials	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	Materials	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	Materials	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%	
	TP Electronics 1 and electrical engineering 1	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	Titled	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
				Course	**T.D.**	**TP**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 2.2.1 Credits: 10 Coefficients: 5	Fundamental Electronics 2	6	3	3:00 a.m.	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%
	Fundamental Electronics TP 2	2	1			1h30	10:30 p.m.	27:30	100%	
	Combinatorial logic TP and sequential	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Numerical methods	2	1			1h30	10:30 p.m.	27:30	100%	
EU Discovery Code: UED 2.2 Credits: 2 Coefficients: 2	Electronic component technology 1	1	1	1h30			10:30 p.m.	02:30		100%
	Elements of physics of electronic components	1	1	1h30			10:30 p.m.	02:30		100%
Transversal EU Code: UET 2.2 Credits: 1 Coefficients: 1	Expression, information and communication techniques	1	1	1h30			10:30 p.m.	02:30		100%
Total semester 4		**30**	**17**	**1:30**	**6:00**	**5:30**	**375h00**	**375h00**		

				p.m.	**a.m.**	**a.m.**				

Semester 5

Teaching units	Materials	Credits	Coefficients	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	Microprocessor Systems	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Electronic Functions	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 3.1.2 Credits: 8 Coefficients: 4	Signal processing	4	2	1h30	1h30		45:00	55:00	40%	60%
	Local computer networks	4	2	1h30	1h30		45:00	55:00	40%	60%
Methodological EU Code: UEM 3.1 Credits: 9 Coefficients: 5	TPMicroprocessor Systems	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Functions of Electronics	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Ssignal andLocal networks	2	1			1h30	10:30 p.m.	27:30	100%	
	Preliminary works	3	2	1h30		1h00	37:30	37:30	40%	60%
EU Discovery Code: UED 3.1 Credits: 2 Coefficients: 2	Electronic Component Technology 2	1	1	1h30			10:30 p.m.	02:30		100%
	Integrated circuit technology and manufacturing	1	1	1h30			10:30 p.m.	02:30		100%
Transversal EU Code: UET 3.1 Credits: 1 Coefficients: 1	Wave Propagation and Antennas	1	1	1h30			10:30 p.m.	02:30		100%
Total semester 5		**30**	**17**	**1:30**	**6:00**	**5:30**	**375h00**	**375h00**		

				p.m.	**a.m.**	**a.m.**				

Semester 6

Teaching units	Materials	Credits	Coefficients	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	Continuous controls and Regulation	6	3	3:00 a.m.	1h30		67h30	82h30	40%	60%
	Sensors and Instrumentation	4	2	1h30	1h30		45:00	55:00	40%	60%
Fundamental EU Code: UEF 3.2.2 Credits: 8 Coefficients: 4	Power electronics	4	2	1h30	1h30		45:00	55:00	40%	60%
	Pulse electronics	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 Controls and Regulation	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Sensorsand Instrumentation	2	1			1h30	10:30 p.m.	27:30	100%	
	TP Power electronics and pulses	1	1			1h00	3:00 p.m.	10:00 a.m.	100%	
EU Discovery Code: UED 3.2 Credits: 2 Coefficients: 2	Optoelectronic Devices	2	2	3:00 a.m.			45:00	05:00		100%
Transversal EU Code: UET 3.2 Credits: 1 Coefficients: 1	Entrepreneurship and business management	1	1	1h30			10:30 p.m.	02:30		100%
Total semester 6		**30**	**17**	**12:00 p.m.**	**6:00 a.m.**	**7:00 a.m.**	**375h00**	**375h00**		

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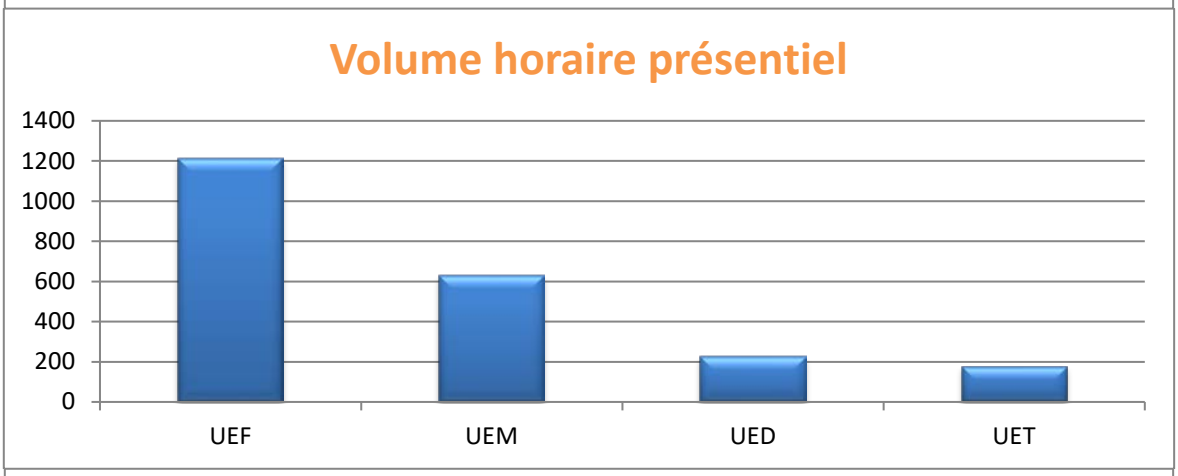
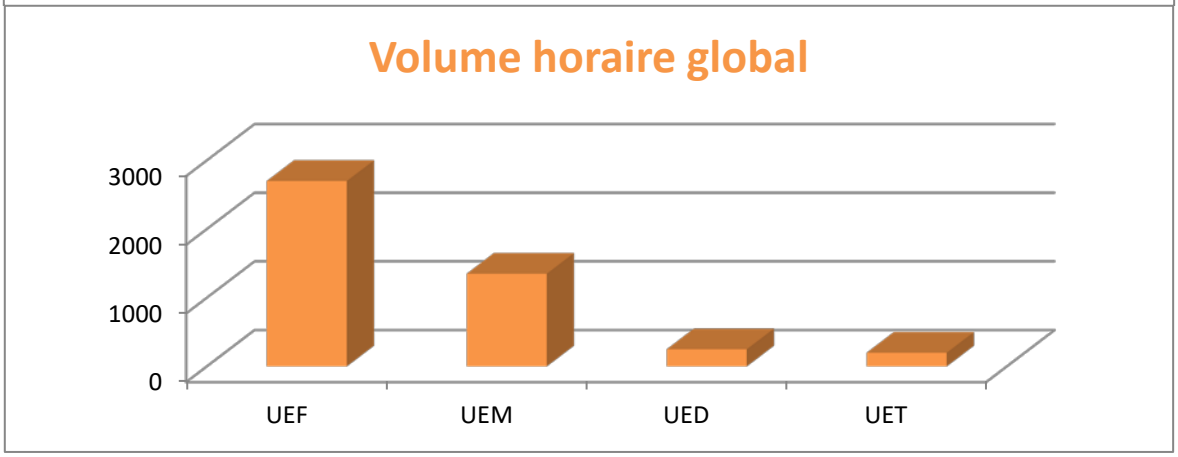
Overall summary of the training:

EU / V.H.	UEF	EMU	UED	UET	Total
Course	720h00	120h00	225h00	180h00	1245h00
T.D.	495h00	10:30 p.m.	---	---	517h30
TP	---	487h30	---	---	487h30
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, Oral expression and 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 mathematics.

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 and 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.

Ann Bridges, How to Pass Higher English, Hodder Gibson-Hachette, 2009.

Semester: 4
Teaching unit: UEF 2.2.1
Subject 1:Fundamental Electronics 2
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

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

Recommended prior knowledge

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: Field effect transistors **3 weeks**

Description, Field effect (JFET/MOSFET), Operating principle, Polarization, Operating regimes, Characteristic networks, Rest point, Static charge line, Common source, common drain and common gate amplifiers.

Chapter 2: Power Amplifiers: **3 weeks**

Definitions, Dynamic load line, Output signal dynamics, Efficiency, Class A power amplifiers, Class B power amplifiers, Push-Pull amplifiers, Class C power amplifiers

Chapter 3: Counter reaction (CR) **3 weeks**

Properties of the feedback, Classification of CR assemblies, CR series-series, CR parallel-parallel, CR parallel-series, CR series-parallel.

Chapter 4: Differential Amplifiers **3 weeks**

Definition, Example of differential amplifier, Voltages and gains of common and differential modes, Differential amplifier with bipolar transistors, principle diagram.

Chapter 5:Sinusoidal oscillators **3weeks**

Introduction, Looped systems, Oscillation conditions, frequency stability, amplitude stability, and stability criteria. Different types of sinusoidal oscillators: Harmonic oscillators, RC oscillators, LC and quartz oscillators.

Evaluation mode:

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

Bibliographic references:

1.HAS.P. Malvino, Principle of electronics, Ediscience.
2. J. Millman, Microelectronics, Ediscience.
3. M. Dubois, Basic electronic components, Laval University, 2006.
4. M. Girard, Discrete active components. Volume 2: Field effect transistors, Ediscience.
5. Ch. Gentili, Microwave amplifiers and oscillators, Masson.
6. F. Milsant,Electronic problems, Chihab-Eyrolles, 1994.

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: UEM 2.2
Subject 2:Fundamental Electronics TP 2
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 "Fundamental electronics 2" through practical work to better understand and assimilate the content of this subject.

Recommended prior knowledge

Fundamental electronics 2.

Content of the material:

The aim of the practical work is to give students the opportunity to carry out electronic assemblies on a test board and then validate their operation using measuring devices.
It is therefore strongly recommended to carry out all the theoretical parts as well as all the calculations before coming to the TP. This is in order to be able to devote your time to measuring and not to sizing the circuit during practical work.
A report will be required at the end of each Practical Work session. This report must include: The theoretical and calculation parts; A qualitative explanation of the montages; Measurement diagrams (diagrams + placement of devices); Measurements, graphs, curves, characteristic readings, etc. ; A discussion of the results, problems encountered, etc.

TP No. 1: Study of the FET and MOS field effect transistor amplifier:

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

TP No. 2: Power amplifiers

- Study of the Class A power amplifier,
- Study of the Class B power amplifier,
- Study of the Class AB power amplifier,
- Study of the Class C power amplifier,
- Study of the Push-Pull Class power amplifier.

TP No. 3: Sinusoidal oscillators:

- Study of the RC oscillator,
- Study of the LC oscillator,
- Study of the Hartley oscillator,

Study of the Colpitts oscillator.

Evaluation mode:

Continuous control: 100%.

Bibliographic references:

1.HAS.P. Malvino; Principle of electronics; Ediscience.
2. J. Millman; Microelectronics; Ediscience.

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: UED 2.2
Subject 1:Electronic component technology 1
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Review basic passive and active electronic components by briefly examining their technological properties. Know more specificallytheir physical aspects, theirsymbols,their applications as well as their common breakdowns.

Recommended prior knowledge

Basic electricity.

Content of the material:

There is no question in this subject of demonstrating or explaining ''in detail'' either a formula or a given manufacturing technology. It is rather a matter of introducing the student ''visually'' to as many components as possible and presenting them in a simplified manner their main characteristics as well as their uses.

Chapter 1: Resistance

- Technological varieties: Agglomerated resistors, Metal film resistors, Carbon layer resistors, Precision wirewound resistors, Power wirewound resistors, Comparison table of different technologies.
- Range of standard values, color code, symbols, resistor characteristics: nominal value, maximum power, tolerance, etc.
- Basic formulas: Ohm's law, Resistivity, Power, Joule effect, Voltage divider, Association of resistances in series and parallel, …
- Uses and applications: Potentiometer, Adjustable, Current limitation, Different uses: Power, precision, high voltage, standard resistance,
- Test and Failures: Test with an ohmmeter, Faults: increase in resistance, circuit break, wear between the wiper and the track (variable resistance)

Chapter 2: Capacitors

- Technological varieties: Plastic film capacitors, Mica capacitors, Ceramic capacitors, Multilayer capacitors with a glass dielectric, Electrolytic capacitors, Tantalum capacitors, Comparison table of the different technologies.
- Range of standard values, color code, symbols, capacitor characteristics: nominal value, maximum voltage, tolerance, etc.
- Basic formulas: Capacity, Electrical rigidity, stored charge, Association of capacitors in series and in parallel, Capacitor inalternating current and direct current, Charge of a capacity, charge constant,
- Uses and applications: Variable capacitor, Link capacitor, Decoupling capacitor, Filtering (RC and CR circuits), Power supply energy reservoir capacitor,
- Test and Failures: Capacitor test with an ohmmeter, with an external DC voltage source, Faults: Broken connections, Polarity reversal (electrolytic capacitor),

Chapter 3: Selfs

- Technological varieties:air coil, core coil, etc.
- Range of standard values, Symbols, Characteristics of chokes.
- Basic formulas: f.e.m. induced in an inductor, Stored energy, Inductances in static and dynamic regimes, Association of inductances in series and in parallel.
- Uses and applications: LC oscillator, Transformer, Solid state relay, …
- Test and Failures: Wire break, Short circuit,

Chapter 4: Diodes

- General: Principle of the PN junction diode, Symbol, Direct and reverse polarizations, Influence of temperature, Current-voltage characteristic, Threshold voltage Vp, Maximum reverse voltage, Maximum direct current IFmax, Maximum dissipated power, Maximum frequency, etc.
- **Range of use of diodes and identification codes:**Signal, switching, detection, power diodes,
- **Basic formulas:**Calculation of rprotection resistance of a diode, Power dissipated,
- **Uses and applications:**Single and double-wave rectification, Filtering, Detection, Clipping, Reverse polarity protection, Logic gate protection, 7-segment display, ...
- **Special diodes and symbols:**Zener, LED, Photodiode, Varicap, …
- **Test and Failures:**Identification of the cathode,Testing a standard diode, Testing a diode bridge,Faults: Wire breakage, Short circuit,

Chapter 5: Transistorsbipolar

- **General:**Operation of the transistor, Npn and pnp transistors, Symbols, Bias of the npn transistor, Bias of the pnp transistor, Current-voltage characteristic network: Electrical quantities associated with the transistor (VBE, VCB, VCE, IC and IB), Static gain, Maximum frequency ,
- Range of use of transistors and identification codes: LF transistor, HF transistor, Low power transistor, High power transistor, Power dissipation (radiator), Different transistor cases: TO1, TO3, TO5, TO92, TO220 ,…
- **Basic formulas**: Relations between IC, IE and IB currents,The transistor in saturation mode,The transistor in amplification
- **Uses and applications**: Voltage and current amplifications, The transistor: a switch,
- **Test and Failures:**Identifying the transistor legs, breakdowns.

Chapter 6: Logic integrated circuits

- **General:**Analog electronics, Digital electronics, Binary logic, TTL technology, CMOS technology,Summary of TTL and CMOS logic levels at input and output.
- **Identification**: TLL logic (54 and 74 series), CMOS logic (CD40 series), Characteristics of TTL and CMOS logic circuits: speed, power consumption, power supply range,
- **Uses and applications**: The different logic gates NOT, AND, OR, …
- **Test and Failures**:Entries in the air, Brochage,How to test a logic circuit:checking logic gates

Chapter 7: Analog circuits

- General: Identification of some manufacturers,Enclosures (DIL, TOxx),Integrated circuit supports,
- **The main analog circuits:**The 78xx and 79xx voltage regulators, LM 317, the 741 op-amps, etc.
- Testing and breakdowns:

Evaluation mode:

Final exam: 100%.

Bibliographic references:

1- R. Besson, Electronics with transistors and integrated circuits, Technique and Popularization, 1979.
2- R. Besson, Technology of electronic components, Editions Radio.
3- M. Archambault, Practical training in electronics, Ed. Techniques et -Scientifiques Françaises, 2007.
4- B. Woollard, Taming the components, Dunod, 1997.
5- P. Maye, Electronic components cheat sheet, Dunod, 2010.
6- P. Mayeux, Learning electronics through experimentation and simulation, ETSF, 2006.
7- R. Mallard, Electronics for beginners, Elektor, 2012.

Semester: 4
Teaching unit: UED 2.2
Subject 2:Elements of Physics of Electronic Components
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Help the student acquire the basic notions allowing them to understand the physics of semiconductors and finally the operation of semiconductor-based components.

Recommended prior knowledge

Basic notions of atomic physics.

Content of the material:

The number of weeks displayed are indicated for information purposes only. The course manager is not required to strictly respect this dimensioning or the arrangement of the chapters. Be careful as much as possible to get to the essence of the phenomena without dwelling too much on the details.

Chapter 1. Concepts of semiconductor physics (4 weeks)

Definitions, conductor, insulator and semiconductor in relation to conductivity (resistivity), definitions in relation to energy bands, semiconductor materials, crystal structure of semiconductors, intrinsic semiconductor, conduction of a semiconductor -intrinsic conductor, concept of hole, recombination, intrinsic concentration, extrinsic semiconductor, N-type semiconductor, P-type semiconductor, position of Ed and Ea levels, Gap concept, direct gap, indirect gap, phenomena conduction and diffusion in semiconductors, conduction by electron or hole, mobility of charge carriers, conduction current, conductivity, resistivity, diffusion current, Einstein relation.

Chapter 2. PN junction (4 weeks)

The non-polarized PN junction (at equilibrium), formation of the space charge zone, potential barrier, characteristics of the space charge zone (electric field distribution, potential distribution, diffusion voltage, thickness of the space charge zone), the polarized PN junction, effects of a positive polarization, effects of a negative polarization, junction capacitance, current-voltage characteristics of a PN junction,Examples of use: rectifier diode, tunnel diode, Zener diode, variable capacitance diode, Schottky diode.

Chapter 3. Bipolar Transistor (3 weeks)

Description, NPN structure, PNP structure, symbols, operating principle of a bipolar transistor, transistor effect, conditions for observing the transistor effect, operating regimes of a bipolar transistor, direct normal regime, inverse normal regime, regime saturated, blocked diet, Examples of use: bipolar transistors in amplification mode and in switching mode.

Chapter 4. Field Effect Transistors (4 weeks)

- JFET transistor, description, N-channel JFET, P-channel JFET, symbols, operating principle of a JFET, operating regimes of a JFET, linear regime (ohmic), non-linear regime, saturated regime,Examples of uses: analog switch, resistance controlled by a voltage.
- MOSFET transistor, description, N and P channel depletion MOSFET, N and P channel enrichment MOSFET, symbols, MOS structure, accumulation regime, depletion regime, inversion regime, operating principle of a MOSFET, MOSFET depletion, enrichment MOSFET, operating regimes of a MOSFET, linear (ohmic) regime, non-linear regime, saturated regime, Examples of uses: CMOS logic inverter, dynamic RAM.
- Floating gate MOS transistor,Description, Principle of use,Application example: EPROM memories.

Evaluation mode:
Final exam: 100%.

Bibliographic references:

1. H. Mathieu, “Physics of semiconductors and electronic components”, 6th edition, Dunod, 2009.
2. M. Mebarki, “Physics of semiconductors”, OPU, Algiers, 1993.
3. C. Ngô and H. Ngô, “Physics of semiconductors”, 4th edition, Dunod.
4. J. Singh, “Semiconductors Devices: An Introduction”, McGraw Hill, 1994.
5. DA Neamen, “Semiconductor Physics and Devices: Basic Principles”, McGraw Hill, 2003.
6. McMurry and Fay, “Chemistry; Prentice Hall”, 4th edition, 2003.

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:Microprocessor Systems

VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

Continue the study of sequential circuits started in semester S4. Teach the student the architecture, operation and programming of an 8-bit microprocessor, finally making them acquire the operating mechanisms of a microprocessor system (interfacing, interruption) as well as its programming in assembler.

Recommended prior knowledge

Combinatorial and sequential logic, Concepts of programming and algorithms.

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. Semiconductor memories (2 weeks)

Reminders about shift registers. Definition, Memory capacity unit (bits, kb, MB, GB), Sequential and random memory access, Different memory technologies (magnetic, semiconductor, Electro-optical), Different types of semiconductor memories (ROM, EPROM , UVPROM, EEPROM, FLASH-EPROM, RAM, SRAM, DRAM), General characteristics, Internal organization, Types of the memory element (diode, transistor, MOS capacity, etc.), Criteria for choosing a memory, timing diagram of read/write cycles, Access time, Read and write time, etc., Extension of memory capacity (association of RAM or ROM boxes or others), Calculation of the number of memory boxes, Decoding of addresses, Creation of 'a memory plan.

Chapter 2. History and evolution of computers (1 week)

History, the first computers, Different types of computers (giant, mini, micro), Organization of a computer into functional blocks (central unit, memory, input unit, output unit) and their descriptions, Computer peripherals inputs and outputs, The different buses and their functions (data bus, address bus, control bus), Computer vocabulary (bit, word, byte, program, Binary information (data, address, instruction), Clock, Microprocessor, Architecture of a microprocessor system, Von Neumann architecture, Harvard architecture.

Chapter 3: Study of an 8-bit microprocessor (6 weeks)

General, The different families of 8-bit microprocessors (Intel 8085, Motorola 6800, MOSTEK 6502, Zilog Z80, etc.), Compatibility between microprocessors, Upward compatibility, Preeminence of Intel and Motorola microprocessors, etc., Detailed study of a type of microprocessor 8 bits, Pinout and external signals, internal architecture, Description and associated registers, Coding of an instruction on 1, 2 or 3 bytes, Addressing modes, Instruction set, Instruction families (transfer, logic, Arithmetic, Connections , Stack and I/O management), Example applications for each group of instructions with simple examples, Examples of assembly programs.

Chapter 4. Input/output interfaces (4 weeks)

Introduction (definition, role and need for an I/O interface), Different types of interfaces (parallel interface, serial interface, Timer, programmable interrupt controller, etc.), Descriptions and internal architectures of these interfaces, Examples programming of one or two I/O circuits: addressing of I/O ports, configurations.

Chapter 5. Interruptions (2 weeks)

General, Data exchange protocols (by device status test (polling), by interrupt, by direct memory access), Maskable interrupts and non-maskable interrupts, Interrupt processing process, Examples of subroutines interruption.

Evaluation mode:

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

Bibliographic references:

1. J. Letocha, "Introduction to Logic Circuits", 2ed Mc-Graw Hill, 1997.
2. JM Bernard, J. Hugon, "From hardwired logic to microprocessors, Volumes 1 to 4" Eyrolles.
3. R. Delsol, "Digital electronics, Volumes 1 and 2" Edition Berti.
4. P. Cabanis, "Digital electronics" Edition Dunod.
5. M. Gindre, "Sequential logic" Edition Ediscience.
6. JP Vabre and JC Lafont, "Courses and problems in digital electronics" Ellipses, 1998.
7. R. Katz, "Contemporary Logic Design", 2nd Ed., Prentice Hall, 2005.
8. M. Aumiaux, "The use of microprocessors" Masson, Paris, 1982.
9. M. Aumiaux, "Microprocessor systems", Masson, Paris, 1982.
10. RL Tokheim, "Microprocessors, Volumes 1 and 2" Schaum series, McGraw Hill.
11. JC Buisson, "Designing your microprocessor, structure of logical systems" Ellipses, 2006.
12. A. Tanenbaum, "Computer Architecture" Dunod.
13. P. Zanella, Y. Ligier, E. Lazard, "Computer architecture and technology" Dunod.
14. JM Trio, "8086-8088 microprocessors: Architecture and programming, 8087 calculation coprocessor", Eyrolles.
15. H. Lilen, "Fundamental course of microprocessors" Dunod, 1993.
16. JC Buisson, "Designing your microprocessor: Structure of logical systems" Ellipses, 2006.
17. T. Floyd, "Numerical systems", Eyrolles, 9th edition.
18. PA Goupille, "Computer technologyand networks", 8th edition, Dunod.
19. SKSen, "Understanding 8085/8086 Microprocessors and Peripheral", New Age International (P) Ltd., Publishers, Second edition
20. F. Anceau&D. Etiemble, "Introduction to computer architecture", Edition Technique de l'Ingénieur, 2010.
21. D. Etiemble, "Evolution of computer architecture", Edition Technique de l'Ingénieur, 2009.
22. D.A. Patterson&J. L. Hennessy, "Computer Organization and Design, The hardware/software interface", Morgan Kaufmann, Fourth Edition.
23. LA Leventhal&W. Saville, "8080/8085 Assembly Language subroutines," McGraw-Hill.
24. Intel 8080/8085 Assembly Language Programming, Intel Corporation, 1977.
25. DA Godse&A.P.Godse, "Microprocessors and Interfacing", Technical Publications.
26. S. Leibson&M. Jacob, "Handbook of Interfaces", McGraw-Hill.
27. JC Buisson, "Designing your microprocessor: Structure of logical systems", Ellipses.
28. Alain Cazes&Joëlle Delacroix, "Architecture of machines and computer systems", Dunod, 3rd edition.
29. L. Null&J. Lobur, "The Essentials of Computer Organization and Architecture," Jones and Bartlett Publishers.

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

Teaching objectives:

The objective of this subject is to acquire basic theoretical knowledge on different electronic functions necessary to design and implement a transmission system. Functions as diverse as analog filters, amplitude, frequency and phase modulations and demodulations, PLLs, etc. are processed.

Recommended prior knowledge

Fundamental electronics 1 and 2.

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. Analog filters (3 weeks)

Definitions (transfer function, filtering, passive filter and active filter), Main templates (template of a low pass filter, template of a high pass filter, template of a band pass filter and template of a notch filter) , Reminders on low pass filters (first order low pass, second order low pass), Study of Butterworth and Tchebyshev filters (Butterworth low pass filter, Tchebyshev low pass filter), Transformations, Active filters (Salen-structure Key of order 2, Rauch structure of order 2), Cascade synthesis method

Chapter 2. Amplitude modulation and demodulation (3 weeks)

General information on the signals to be transmitted (spectrum of a signal, non-linear system), Purpose of modulation, Structure of a telecommunications system, Analog modulation, Double sideband amplitude modulation with carrier (principle, temporal representation of the AM signal, spectral representation of the AM signal, power of an AM signal, generation of an AM signal), Double sideband amplitude modulation with suppressed carrier (principle, generation of an AM signal without carrier), Modulation single sideband amplitude (principle, generation of an AMBLU signal by the phase shift method), Amplitude demodulation, Demodulation of an amplitude modulated signal with carrier (synchronous or coherent demodulation, non-synchronous or non-coherent demodulation (envelope detector)), Demodulation of the AM signal with suppressed carrier, Demodulation of a single sideband AM signal.

Chapter 3. Angular modulations and demodulations (FM and PM) (3 weeks)

General, FM frequency modulation, Expression of a frequency modulated wave, Spectrum of an FM signal (Bessel functions of the first kind), Frequency band, Power in FM signals, Frequency modulators, Demodulation of FM signals , PM phase modulation, Expression of a phase modulated wave, Phase deviation, Frequency deviation, Phase modulators, Spectral occupancy of the PM signal, Comparison between angular modulations (FM and PM).

Chapter 4. Phase-locked loop (PLL) (3 weeks)

Operating principle, loop gain, tracking range, latching range, dynamic operation of a 1st order and 2nd order loop, applications, synchronization, application to frequency modulation and demodulation, frequency synthesizers.

Chapter 5. Introduction to digital modulations (3 weeks)

Principle of a digital transmission chain, digital modulations (ASK, FSK and PSK, etc.), examples of power spectra (DSP), digital demodulations ASK, FSK and PSK; Pulse modulation (Carrier spectrum and Pulse amplitude modulation).

Evaluation mode:

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

Bibliographic references:

1. AP Malvino, "Principles of Electronics", 6 edition; Sciences-Sup, Dunod.
2. P. Rochette, "Fundamentals in Electronics", Technosup, Ellipses.
3. J. Millman, "Microelectronics", Ediscience.
4. J. Encinas, "Phase-locked system (PLL): achievements and applications".
5. P. Brémaud, "Signal and communications: Modulation, coding and information theory", Ellipses.
6. HH Ouslimani, A. Ouslimani, "Main functions of electronics", Casteilla, 2010.
7. JM Poitevin, "Electronics: Main functions", Dunod, 2003.
8. G. Baudoin, "Radiocommunication", Dunod, 2007.
9. Y. Mori, "Electronics for signal processing," vol. 4; Lavoisier, 2006.
10. F. Milsant, "Electronics course" volume 4; Eyrolles, 1994.
11. F. Biquard, "Amplitude modulation" Technosup, Ellipses, 1998.

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

Teaching objectives:

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

Recommended prior knowledge

Signal theory, Mathematics 3, Fundamental electronics 1, Probability and statistics.

Content of the 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. Reminders of the main results of Signal Theory (1 week)
Signals. Fourier series. Fourier transform and existence conditions. Parseval's theorem.Plancherel's theorem. Convolution and correlation.

Chapter 2.Random processes (4Weeks)
Notions on random variables (discrete and continuous, probability density, mathematical expectation, variance, standard deviation, etc.), Characteristics of random processes: average, autocorrelation functions, inter-correlation, stationarity in the broad and narrow sense , ergodism, power spectral density. Specific processes (Gauss process, Poisson process, telegraph signal, pseudo-random sequences). Noises (thermal noise, shot noise, etc.)

Chapter 3. Analysis and synthesis of analog filters (3Weeks)
Reminders on the Laplace transform. Temporal and frequency analysis of analog filters. Poles, zeros, p plane and Stability of analog filters. Passive and active filters, First and second order low pass filters, First and second order high pass filters, Band pass filters.Other analog filters (Butterworth, Chebyshev I and II, Ellipticals, etc.)

Chapter 4.Signal Sampling (3Weeks)
Sampling: Principles and definition (theoretical, averaging, blocking etc.). Anti-aliasing filter. Shannon condition. Restitution of the analog signal and interpolator filter. Quantizations, quantization noise. Examples of Analog-to-Digital Conversion and Digital-to-Analog Conversion.

Chapter5.Discrete Transforms (4 weeks)
Definition of TFTD (Discrete Time Fourier Transform), TFD (Discrete Fourier Transform), inverse TFD, Relationship between Fourier transform and TFD, Weighting windows, Properties of TFD and circular convolution, Fast algorithms of the TFD (FFT).Z transform and introduction to digital filtering (interest, equationstemporal,transfer function, classification, realization structures, etc.).

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 Presses Polytechniques et Universitaires Romandes.
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.

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

Teaching objectives:

Introduce students to the world of telecommunications by teaching them the basic concepts of traditional and emerging local computer networks. Master the specific constraints of local networks. Choose a local network and associated equipment. Size, install, configure, diagnose a local network.

Recommended prior knowledge

Combinatorial and sequential logic.

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.

VSchapter 1. Concepts on data transmission (2 weeks)
Digital transmission systems (Introduction, standardization organizations, transmission medium and channels, principle of a data link), data transmission (Operating modes, bandwidth, modulation speed, bit rate, etc.), serial transmission and parallel transmission, synchronous and asynchronous transmission, transmission techniques, transmission media and means.

Chapter 2. Local networks (3 weeks)
The main organizations, IEEE model, network classification, the OSI model, the main components of a network, the different physical topologies.

Chapter 3. Ethernet Network (3 weeks)
Presentation (Addressing and Ethernet Frame), access method: CSMA/CD, rules and laws for the Ethernet Network, Ethernet frame formats, topologies, cables and connectors. Interconnection, repeaters, hubs, bridge, switches. Concepts on the evolution of Ethernet networks (Fast Ethernet and Gigabit Ethernet, etc.)

Chapter 4. The TCP/IP protocol (5 weeks)
Presentation of the TCP/IP Model and comparison with OSI. Internet layer: ARP/RARP, IP and ICMP. IPv4 addressing: nomenclature, address classes,subnet mask, subnets and supernets, UDP, TCP.Address with class, Address without class, network segmentation, connectivity test (ping, tracert and pathping commands, etc.). IPv6 address, migration from IPv4 to IPv6

Chapter 5. Wireless local networks (WIFI) (2 weeks)
Introduction to WLAN (Wireless Local Area Network), presentation of WiFi or 802.11, features of the MAC layer. Access methods. Different topologies with and without infrastructure (or access point).

Evaluation mode:

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

Bibliographic references:

1. G. Pujolle; Networks, 3rd edition; Eyrolles, 2002.
2. Tanenbaum; Networks, 4th edition; Prentice hall, 2003.

3. A. Perfect; Telecommunications networks; Hermes science publications, 2002.
4. E. Hollocou; Telecommunications techniques and networks; Armand Colin, 1991.
5. C. Servin; Networks and telecoms; Dunod, Paris, 2003.
6. D. Dromard and D. Seret; Network architectures; Pearsont Editions, 2009.
7. P. Polin; Networks: fundamental principles; Hermès edition.
8. D. Comer; TCP/IP, architectures, protocols and applications; Editions Inter éditions.
9. D. Present, S. Lohier; Transmissions and Networks, courses and corrected exercises; Dunod.
10. P. Clerc, P. Xavier; Fundamentals of Telecommunications; Ellipses, Paris, 1998.
11. D. Battu; Introduction to Telecoms: Technologies and Applications; Dunod, Paris, 2002.

Semester: 5
Teaching unit: UEM3.1
Subject 1:TPMicroprocessor Systems
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

Based on the knowledge of the internal architecture of a specific 8-bit microprocessor, the related input-output circuits as well as the exploitation of the associated instruction set, the student will be able to design, interface, program a microprocessor system for a defined application.

Recommended prior knowledge

Microprocessor Systems.

Content of the material:

TP1: Familiarization with the educational kit dedicated to the 8-bit microprocessor studied or with the dedicated microprocessor simulator.

TP2: Use of transfer instructions, arithmetic and logic instructions.

TP3: Use of branching instructions and programming loop techniques.

TP4: Writing and simulating assembly programs
(Multiplication, division, searching for information in a list, sorting information, etc.).

TP5: Using stack management and I/O instructions

TP6: Assembler programming (and simulation) of I/O interface circuits
(parallel, series, timer, etc.): Flashing, intersection lights, monitoring of a premises,…

Evaluation mode:

Continuous control: 100%.

Bibliographic references:

1. M. Aumiaux, “The use of microprocessors”, Masson, Paris, 1982.
2. M. Aumiaux, “Microprocessor systems”, Masson, Paris, 1982.
3. RL Tokheim, “Microprocessors”, Volumes 1 and 2; Schaum series, McGraw Hill.
4. JC Buisso, “Designing your microprocessor, structure of logical systems”, Ellipses, 2006.
5. A. Tanenbaum, “Computer Architecture”, Dunod.
6. P. Zanella, Y. Ligier, E. Lazard, “Computer architecture and technology”, Dunod.
7. JM Trio, “8086-8088 microprocessors: Architecture and programming, 8087 calculation coprocessor”, Eyrolles.

Semester: 5
Teaching unit: UEM 3.1
Subject 2:TP Functions of Electronics
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

Consolidate the knowledge acquired in the subject "Functions of Electronics" through practical work to better understand and assimilate the content of this subject.

Recommended prior knowledge

Functions of Electronics.

Content of the material:

TP1:Study ofactive filters: check and test the different active filter functions
(Low pass, high pass, band pass).

TP2:Study of amplitude modulation, study of amplitude demodulation

TP3:Study of frequency modulation, study of frequency demodulation

TP4:Principle of IF amplification with AM and CAG detector
(Automatic gain control).

Evaluation mode:

Continuous control: 100%.

Bibliographic references:

1. AP Malvino, "Principles of electronics", 6 edition, Sciences-Sup, Dunod
2. P. Rochette, "Fundamentals in Electronics", Technosup, Ellipses.
3. J. Millman, "Microelectronics", Ediscience.
4. HH Ouslimani, A. Ouslimani, "Main functions of electronics", Casteilla, 2010.
5. JM Poitevin, "Electronics: Main functions", Dunod, 2003.
6. F. Milsan, "Electronics course", volume 4, Eyrolles, 1994.
7. F. Biquar, "Amplitude modulation", Technosup, Ellipses, 1998.
8. L. Vandendorpe, "Analogue modulations", Catholic University of Louvain; Belgium.

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

Teaching objectives:

Consolidation of acquired knowledge of theory and signal processing using a scientific programming language (Matlab, Scilab or Mathématica, etc.).
Introducing the student to preparing cabling for a network and creating a network using a switch.

Recommended prior knowledge

Numerical methods, Computer science 2 and computer science 3, Theory and signal processing. Local computer networks.

Content of the material:

This subject is split into 2 distinct TP units:Treatment of ssignal and thelocal computer networks. The teacher(s) choose 3 to 4 practical exercises from each unit from the list of practical exercises presented below.

TP of treatment of ssignal

TP1:Getting started with Matlab
Reminders on usual commands:

- Help (Matlab help), Variables, Basic operations, Character string, Display, Input/output,Files (script/function), …
- Upgradefor using Matlab toolboxes [Toolbox /Matlab, signal and Simulink].

TP2:Generation and display of signals

- Sine, pulse, step, gate, rectangular, square, triangular, sawtooth,cardinal sine signal;Sampling study.

TP3: Fourier series

- Real, Complex, Signal Energy.

TP4:Transformation ofDirect and inverse fast Fourier (fft, ifft)

TP5:Analysis and synthesis of analog filters

TP6:Analysis and synthesis of digital filters

TP7:Random processes

Practical work on local computer networks:

TP1:Creation and testing of RJ45 or twisted pair cables
(Crossed, right).

TP2:Implementing a peer-to-peer network between two PCs
(IP addressing, Folder sharing).

TP3:Configuring and implementing a multi-station network with switches
(IP addressing, tests with ipconfig, ping, arp, tracert, etc.).

TP4:Creating a WiFi network and configuring an access point
(Static and dynamic IP addressing by DHCP, access point security, etc.)

TP5:How TCP/IP protocols work
Encapsulation process by analysis of data frames (Using Wireshark).

NB: Practical work can be carried out on a real local computer network and/or using a simulator.

Evaluation mode:

Continuous control: 100%

Bibliographic references:

Semester: 5
Teaching unit: UEM 3.1
Subject 4:Preliminary works
VHS: 37h30 (Class: 1h30, TP: 1h00)
Credits: 3
Coefficient: 2

Teaching objectives:

This subject concerns the design of simple electronic assemblies: analysis, operating principle, calculation of components and production. It allows the student to put into practice the knowledge acquired during their training by carrying out analog or digital electronic functions on printed circuits.

Recommended prior knowledge

Electronic Component Technology 1, Electrical and Electronic Measurements.

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. Electronics drawing techniques (3 weeks)
Reminders on passive and active components, principles and properties, technological characteristics, areas of use, introduction to electronics drawing, synoptic diagram, developed diagram, equivalent diagram, layout drawings, wiring plan, definition drawing, parts lists.

Chapter 2. Technology of making electronic diagrams (3 weeks)
International grid, preliminary models, arrangement of elements (active elements, passive elements, integrated circuits, radiator, transformers, power elements).

Chapter 3. Electronic circuit wiring technique (3 weeks)
Printed wiring, constituents, properties, establishment of the electrical circuit design, creation of the negative (methodology and software), transfer onto copper by photoengraving, engraving of the copper, treatment after etching, verification and machining of the circuit, modification and repair of the circuit, Circuits in cms, theoretical approach and examples.

Chapter 4. Basics of Troubleshooting Electronic Circuits (3 weeks)
Failure of components, causes of failures (environmental operating constraints), measuring instruments, test methods.

Content of the Practical Work part: (3 weeks)

Presentation of electronic components, introduction to the use of measuring devices, welding techniques, welding of components, familiarization of the student with practical problems, criteria for choosing mini-projects, use of computer software for producing negatives.

For information purposes, below is a non-exhaustive list of projects which could be proposed to students for realization. Obviously, the person responsible for this subject as well as the student are free to propose the creation of other arrangements.

Work on the mini-project can be started from the start of the semester in order to give the student sufficient time to choose the subject, do bibliographic research, understand electronic assembly, research and calculate component values. and above all the concretization of the acquired knowledge of this subject with practical manipulations.

This work must finally be crowned by a report and an oral or poster presentation in front of the subject manager alone or in front of a group of teachers.

Mini project n°1: Study and creation of a classic 12 V DC, 5A power supply.

Mini project n°2: Study and production of an audio amplifier with integrated circuits.

Mini project n°3: Study and creation of a timer and ramp generator with NE555.

Mini project n°4: Study and creation of a sequencer with logic circuits.

Mini project n°5: Study and creation of a triac dimmer.

Mini project n°6: Study and creation of a sound switch.

Mini project n°7: Study and creation of a logic circuit tester.

Mini project n°8: Study and creation of a passive component curve tracer.

Mini project n°9: Study and creation of a multi-stage amplifier.

Evaluation mode:

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

Bibliographic references:

1. P. Gueule; Printed circuits and PCs; Dunod, 2004.
2. J. Alary; Printed circuits in practice: Detailed and economical methods of manufacturing printed circuits; Dunod, 1999.
3. P. Dunand; Printed circuit layouts, electromagnetic compatibility.
4. H. Mostefai; Troubleshooting electronic circuits; Lamine Editions.
5. R. Besson; Electronic component technology; Radio Editions.
6. E. Lowenber; Electronics: Principles and applications; McGraw Hill, 1978.
7. Mr. Fray; Electronics diagrams: Principles and methods; Masson & Cie, 1967.

Semester: 5
Teaching unit: UED 3.1
Subject 1:Electronic Component Technology 2
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

It is a continuation of the same subject taught in S4 and which consists of reviewing specific electronic devices that are usually encountered in electronic assemblies. The aim is to demystify them by exposing their general characteristics and their usual applications.

Recommended prior knowledge

Electronic component technology 1.

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.

The spirit of the subject "Electronic Component Technology" is retained. For each of the ICs, briefly present the definitions, areas of use, truth tables, internal architectures, coding, boxes and pinouts, and a small useful diagram.
Also indicate, whenever possible, the power supply range of the circuits, the power consumption, the current consumed at the input, the current supplied at the output, the voltage drop, the operating frequency band, etc. .

Chapter 1. Power Supply Design (1 week)
Battery or sector?, transformers, rectification, filtering, voltage stabilization, variable power supply, constant current power supply, integrated regulators (78xx and 79xx regulators, LM317 regulator), Small useful diagram.

Chapter 2. Active power components (2 weeks)
For each of the following components, recall the operating principle, technological properties, characteristic networks, symbols, coding and typical values, areas of use, the thyristor or SCR, the GTO thyristor, the triac, the diac, the effect transistor field (TEC or FET), the unijunction transistor or UJT, a small useful diagram.

Chapter 3. Optoelectronic components (2 weeks)
For each of the following components, recall the operating principle, technological properties, symbols, coding and typical values, areas of use and application diagrams: LEDs (7-segment, 16-segment displays, 5x7 matrices, liquid crystals or LCD) , photoresist cells, photodiodes, the phototransistor, the photomultiplier, opto-couplers, the practice of infrared, a small useful diagram.

Chapter 4. TTL family circuits (2 weeks)
Characteristics of standard TTL family logic gates, open collector gates, other TTL families, electrical characteristics of the families: Supply voltages, input and output voltages and currents, High and Low levels, noise immunity, fanout , consumption, switching characteristics: switching speed, propagation delay, three-state circuits, Logic gates with specific inputs: Schmitt trigger, "buffered" outputs, precautions for using TTL circuits.

Chapter 5. CMOS Family Circuits (1 week)
P-MOS and N-MOS logic gates, complementary MOS logic, CMOS families, electrical characteristics of CMOS circuits, TTL-CMOS interfacing, precautions for using CMOS circuits.

Chapter 6. Special Logic Integrated Circuits (ICs) (2 weeks)
TTL or C.MOS? technology, summary of the input and output logic levels, the different logic gates, the decoder ICs, the multiplexer ICs, the comparator ICs, the binary/7-segment converters, the different logic flip-flops, the counter ICs (binary and decade), 555 timer ICs, monostable ICs, useful little diagram.

Chapter7. Other specific components and accessories (2 weeks)
The relay: operation, the power supply of a relay, the different types of relays, solid state relays, a small useful diagram, the microphone, the speaker, the buzzer, the quartz.

Chapter 8. Component documentation (1 week)
Main component manufacturers and identification acronyms, various forms of documents (application notes, catalogs, internet, etc.) Equivalences, examples of content of a technical manual for the most used components.

Evaluation mode:
Final exam: 100%.

Bibliographic references:

1. R. Besson, "Electronics with transistors and integrated circuits; Technique and Popularization", 1979.
2. R. Besson, "Electronic component technology", Editions Radio.
3. M. Archambault, "Practical training in electronics", Editions ETSF, 2007.
4. B. Woollard, "Taming the components", Dunod, 1997.
5. P. Maye, "Electronic components cheat sheet", Dunod, 2010.
6. P. Mayeux, "Learning electronics through experimentation and simulation", ETSF, 2006.
7. R. Mallard, "Electronics for Beginners," Elektor, 2012.
8. F. Cerf, Optoelectronic components, Hermes-Lavoisier, 2000.

Semester: 5
Teaching unit: UED 3.1
Subject 2:Integrated circuit technology and manufacturing
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

The aim of this material is to explain in a very simplified manner the processes conventionally used to manufacture passive and active integrated components and to indicate the essential characteristics of the different technologies and logic families.

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.

The teacher can get help in teaching this subject by downloading, from the Internet, popular science documentaries such as the "It's not rocket science" series; "How it works", have them viewed in part and comment on them.

Chapter 1: Introduction to microelectronics (1 week)
Brief history of integrated circuits. Analog integrated circuits and digital integrated circuits. Degree of circuit integration. Moore's Law. Schematic description of the stages of planar technology.

Chapter 2: Manufacturing of monocrystalline silicon substrates (2 weeks)
Transition from sand to metallurgical grade silicon MG-Si. Preparation and purification of electronic grade polycrystalline semiconductor material. Drawing and growth of the monocrystalline ingot. Cutting of Si wafers.

Chapter 3: Silicon doping techniques (2 weeks)
Intrinsic silicon and band structure. Concept of doping of a semiconductor. Doping by ion implantation. Thermal annealing. Doping by thermal diffusion. Concentration profile.

Chapter 4: Silicon Oxides and Nitride (2 weeks)
Principle of thermal oxidation. Technique for deposition of silicon oxide and silicon nitride.

Chapter 5: Thin layers (2 weeks)
Thin metallic layers. Epitaxy growth of monocrystalline silicon. Polycrystalline silicon deposit.

Chapter 6: Photolithography and engraving techniques (2 weeks)
Main lithography techniques. Chemical etching and dry etching of silicon, insulating layers and metal layers.

Chapter 7: The clean room and the editing room (2 weekss)
White room. Effect of contamination. Assembly and electrical insulation of components, Encapsulation.

Chapter 8: Examples of manufacturing processes (2 weeks)
Manufacturing process in bipolar technology, Manufacturing process in C-MOS technology. Fabrication of a logic gate.

Evaluation mode:
Final exam: 100%.

Bibliographic references:
1-O. Bonnaud, Microelectronic technology, Ellipses, 2008.
2- H. Xiao, Introduction to Semiconductor Manufacturing Technology, SPIE, 2012.
3- A. Berezine, Technology and construction of integrated circuits, Edition Mir, 1986.
4- H. Mathieu, Physics of semiconductors and electronic components, Dunod, 2009.
5- P. De Halleux, ASIC specific integrated circuits, Editions Radio, 1988.
6- C. Piguet, Design of CMOS digital ASIC circuits, Edition Dunod, 1990.
7- A. Sedra, Microelectronic Circuits, Oxford University Press, 2004.
8- F. Milsant, Electronics course, Volume 3, Eyrolles, 1984.
9- G. May, Fundamentals of semiconductor manufacturing, Edition Wiley & Sons Publication
10- G. May, Fundamentals of semiconductor manufacturing and process control, Edition Wiley & Sons Publication
11- G. Schwartz, Handbook of semiconductor interconnection technology.
12-H. Félix, Design of VLSI systems, Engineering Techniques, Electronic Treatise, E 2415.
13- J. Encinas, Bipolar silicon integrated circuits, Engineering Techniques, Vol. E 2425.
14- J. de Pontcharra, Integrated bipolar transistors, Engineering Techniques, Vol. E 2427.
15- T. Skotnicki, MOS transistor and its manufacturing technology, Engineering Techniques, Vol. E 2430.
16- T. Skotnicki, CMOS integrated circuits on silicon, Engineering Techniques, Vol. E 2432.
17- G. Dehaine, Assembly of integrated circuits, Engineering Techniques, Vol. E 2435.

Semester: 5
Teaching unit: UET 3.1
Subject 1:Wave Propagation and Antennas
VHS: 10:30 p.m. (Class: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Give the student the basis for understanding the principle of propagation of electromagnetic waves as well as the mechanisms of radio propagation. Calculate the different parameters applicable to the antennas.

Recommended prior knowledge

Vector analysis, partial differential equations, electromagnetic field theory**.**

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.Reminders on vector analysis elements (1 week)
Reminders on scalar and vector operators:A scalar, A vector,Line integral,Surface integral, Volume integral, Scalar and vector products, Coordinate systems, Infinitesimal elements, Differential operator, Stokes' theorem (or rotational) and Ostrogorski's theorem (Green-Ostrogradsky or divergence).Application exercises.

Chapter 2.Maxwell's equations (2 weeks)
Electromagnetic wave, Maxwell's equations, Maxwell's equations in different media,Solving Maxwell's equations using plane waves,Electromagnetic power and Poynting vector. Application exercises.

Chapter 3. Propagation in vacuum and dielectric media (3 weeks)
Electromagnetic waves in a vacuum, Temporal propagation equation, Plane, progressive, monochromatic waves, Reflection/transmission between two LHI media (normal and oblique incidence).

Chapter 4. Propagation of electromagnetic waves in conductive media (1 week)
Maxwell's equations in a conductor, Propagation equation Skin effect, Reflection on a conducting plane.

Chapter 5.General information on Antennas (4 weeks)
History of antennas, definition of an antenna, radiation pattern, isotropic antenna, directivity, bandwidth, input impedance, equivalent diagram and power adaptation. Application exercises.

Chapter 6. Characteristics of some common antennas (4 weeks)
Dipole antenna, Monopole antenna, Yagi-Uda antenna, propeller antenna, horn antenna, parabolic antenna, printed antenna (patch).Application exercises.

Evaluation mode:

Final exam: 100%.

Bibliographic references:

1. F. Gardiol, “Electromagnetism: Treatise on electricity”, Edition Lausanne.

2. P. Rosnet, “Elements of electromagnetic propagation: Fundamental physics”, 2002.
3. G.Dubost, “Free and guided propagation of electromagnetic waves”, Masson, 1995.
4. M. Nekab, “Waves and propagation phenomena”, OPU, 2004.
5. M. Jouquet, “Electromagnetic waves 1: free propagation”, Dunod, 1973.
6. Garing, “Electromagnetic waves in dielectric media: Exercises and corrected problems”, 1998.
7. Garing, “Electromagnetic waves in vacuum and conductive media: Exercises and corrected problems”, 1998.
8. P. Combes, “Mico-waves, passive circuits, propagation, antennas, Courses and exercises”, Dunod, 1997.
9. R.-C. Houzé, “Antennae, Fundamentals”, Dunod, 2006.
10. A. Ducros, “Antennas: Theory and practice, Transmission and reception”, Elektor, 2008.
11. WL Stutzman, GA Thiele, “Antenna Theory and Design”, John Wiley.
12. C. Balanis, “Antenna Theory: Analysis and Design, 3rd Edition”, John Wiley & Sons Inc, 2005.
13. R. Aksas, “Telecommunications: Antennas Theory and Applications”, Ellipses Marketing; 2013.
14. RC. Houzé, “Antennae, Fundamentals”, Dunod, 2006.
15. O. Picon et al. “Antennas: Theory, design and applications”, Dunod, 2009.
16. R.Taillet, “Electromagnetism” Editions De Boeck. Collection Memento Sciences, 2013.

Semester: 6
Teaching unit: UEF 3.2.1
Subject 1:Continuous controls and Regulation
VHS: 67h30 (Class: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

Give students a good knowledge of the classic methods for studying control loops, the modeling of a physical process, the analysis of open and closed loop performances as well as the synthesis of correctors.

Recommended prior knowledge

Fundamental Electronics 1, Maths 1, 2 and 3.

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 enslavements (2 weeks)
History, interests, the notion of Open Loop (BO) and Closed Loop (BF) systems, servo-controls, the general representation of a servo-control, regulators and tracking systems, what is feedback and what are its effects on systems (total gain, stability, external and internal disturbances, sensitivity, etc.)?, examples of real controls.

Chapter 2. Reminders on the Laplace Transform (1 week)

Chapter 3.Modeling of linear servo systems (2 weeks)
Mathematical models: Differential equations, recurring equations system of state equations, impulse response, poles and zeros, frequency responses (model electrical, mechanical (in translation and rotation), thermal, fluidic, and mixed systems, explain properties: linearity, stationarity (invariance), causality, stability; The transfer function, functional diagrams and algebra of functional diagrams.

Chapter 4.Performance of linear systems (3 weeks)
Temporal analysis of 1st order and 2nd order systems, pTemporal performances: rise time, response time, time constant, overshoot, settling time, afrequency analysis, Bode, Nyquist and Black diagrams (gain and phase margins).

Chapter 5.Stability (2 weeks)
Introduction, definition, explanation,Routh criterion, Routh Table, examples of stability evaluation, special cases, examples.

Chapter 6.The precision of a servo system (1 week)
Dynamic precision, static precision, expression of static error, steady state error, class or type of a servo (classes 0, 1 and 2), calculation of errors corresponding to canonical inputs, position errors, of lagging and acceleration, summary table and conclusions, the stability-precision dilemma, rejection of disturbances, summary table and conclusions.

Chapter 7.Roots Locations (2 weeks)
Introduction, mmethod of constructing the locus of roots, pprinciple of the method (Practical rules for constructionand exploitation of the locus of roots, Examples), rules for constructing the locus (Conditions of angles and modules, The number of branches, Axis of symmetry, Starting and ending points, Asymptotic directions, parts of the real axis belonging instead, branch points, Other properties

of the locus of roots), application of the method on some examples (Use of MATLAB software for plotting the locus of roots,application to stability assessment and compensation).

Chapter 8.Examples of capstone projects (2weeks)

Synthesis of phase advance or delay correctors, synthesis of regulators (Proportional, Integral and Derivative actions), revealing their influences on the responses and improvement of system performance.

Evaluation mode:

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

Bibliographic references:

1. M. Rivoire, "Course in automation, Volume 1: Signals and systems", Edition Chihab.
2. M. Rivoire, "Automation course, Volume 2: Analogue servo-regulation-control", Edition Chihab.
3. K. Ogata, "Automatic Control Engineering", Prentice Hall, fifth edition, 2010.
4. BC Kuo, "Automatic Control Systems", Prentice Hall, ninth edition, 2009.
5. J. Di Stefano, "Servo-Driven Systems: Courses and Issues," McGraw Hill Edition.
6JM Allenbach, "Servo systems volume 1", Geneva Engineering School, 2005 edition.
7.Brizeux, "Introduction to the correction of controlled systems", PSI, 2010.
8. Ph. Mullhaupt, "Introduction to the control of dynamic systems course", Ecole Polytechnique Fédérale de Lausanne, 2016.

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

Teaching objectives:

The objective of this course is the study of the digital measurement chain, the associated electronics as well as the different types of sensors.

Recommended prior knowledge

Fundamental electronics 1 and 2, Electrical and electronic measurements.

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. Sensors and acquisition chain (2 weeks)

Electrical quantities and non-electrical quantities; Definitions and general information on sensors; Different types of sensors (passive, active, digital, intelligent, composite); Physical phenomena used in sensors (law of electromagnetic induction, hall effect, thermoelectric effect, magneto-resistive effect, photoelectric effect, piezoelectric effect, Doppler effect, etc.); Overall structure of a complete measurement chain: acquisition, processing, restitution.

Chapter 2. Some metrological characteristics (2 weeks)

Sensitivity, Linearity, Calibration curve, Resolution, Speed, Response time and bandwidth, Limits of use, calibration-measuring range, nominal range of use, non-deterioration zone, Measurement errors, selection criteria 'a captor.

Chapter 3. Passive sensor conditioners (3 weeks)

General characteristics of passive sensor conditioners; Potentiometric assembly (measurement of resistances, measurement of complex impedances, disadvantages of potentiometric assembly); Bridge assembly (Wheatstone bridge, complex bridges: Sauty bridge, Maxwell bridge); the oscillators.

Chapter 4. Signal conditioners (4 weeks)

Adaptation of the signal source to the measurement chain (impedance adaptation, conditioner of the voltage source sensor, conditioner of the charge source sensor); Signal amplification and common mode voltage reduction (Differential amplifier, common mode rejection ratio, instrumentation amplifier, isolation amplifier).

Chapter 5. Some examples of sensors (4 weeks)

The teacher is free to choose the study of some sensors from the list below:
Classification of sensors, temperature sensors, position and displacement sensors, speed and acceleration sensors, pressure sensors, force and strain sensors, pressure, level and flow sensors, optical sensors.

Evaluation mode:

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

Bibliographic references:

1. G. Asch, “Sensors in Industrial Instrumentation”, Dunod, 2010.
2. P. Dassonvalle, “Les Capteurs: Exercises and corrected problems”, Dunod, 2005.
3. T. Lang, “Electronics of measurement systems”, Masson, 1992.
4. G. Asch, “Data acquisition: from sensor to computer”, Dunod, 2003.
5. F. Cottet, “Signal processing and data acquisition: Courses and exercises”, Dunod, 1999.
6. M. Cerr, “Industrial instrumentation”, Volumes 1 and 2; Edition Tech and Doc.
7. G. Asch et al. “Data acquisition”, 3rd edition, Dunod, 2011.
8. P. Oguic, “Measurements and PC”, ETSF Edition.
9. F. Boudoin, M. Lavabre, “Sensors: main uses”, Edition Casteilla, 2007
10. JG Webster, “Measurement, Instrumentation and Sensors Handbook”, Taylor & Francis Ltd.
11. A. Migeon, “Industrial applications of sensors”, Volume 2, Medical, chemical and plastics sectors; Hermès Science Publications, 1997.

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

Teaching objectives:

Introduce the student to other main functions of electronics. This subject associated with ''Functions of electronics'' (semester 5) and ''Fundamental electronics 2'' (semester 4) constitute an entity whose overall content gives the student the ability to analyze the functioning of an analog electronic system as complex as it may be just by examining its detailed diagram appearing in the manufacturer's instructions.

Recommended prior knowledge

Fundamental electronics 1 and 2, Functions of electronics.

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. Definitions and characteristics of impulse (1 week)

Different types of signals: square, rectangular, ramp, triangular, sawtooth, ..., definitions: amplitude, peak, period, alternating signal, continuous signal, ..., positive pulse, negative pulse, duty cycle, pulse train, characteristic time of a pulse, …

Chapter 2. RC circuit in switching (1 week)

Charging and discharging a capacitor, general expression of charging and discharging, forms of the voltages of an RC circuit.

Chapter 3. Active components in switching (1 week)

Diode in switching, diffusion load, transition load, transistor in switching, blocking mode, saturation mode, equivalent diagram of the transistor in switching.

Chapter 4. Fitness circuits (2 weeks)

Diode clipper assemblies, peak detector assemblies, operational amplifiers in non-linear mode: single-threshold comparator, hysteresis comparator, Schmitt trigger with operational amplifier, Schmitt trigger with logic gates, Schmitt trigger based on the NE555 timer.

Chapter 5. A/D and D/A converters (4 weeks)

Introduction to signal digitization, analog-to-digital conversion, principle of A/D conversion, characteristics of an A/D converter, study of ADC examples: single and double ramp integration converter, successive approximation converter, converter flash, specifications: conversion range, resolution, conversion speed, errors: quantization, gain, offset, linearity, precision.
Sample-and-hold circuit, operating principle, discharge rate, selection criteria for sample-and-hold circuits.
Digital-to-analog conversion, principle of D/A conversion, study of DAC examples: weighted resistor converters, R/2R network converters, specifications: conversion range, settling time, errors: integral nonlinearity , differential nonlinearity, shift.

Chapter 6. Two-state circuits: Multivibrators (3 weeks)

The bistable circuit: with transistors and op-amp, the monostable circuit: with transistors and op-amp, the astable circuit: with transistors and op-amp, the monostable integrated circuit: symbol and time diagram, retriggerable monostables and not retriggerable.

Chapter 7. Function generators (3 weeks)

Ramp generators: constant current generator, Miller integrator, constant current ramp generator, signal generator in integrated circuits, principle of generating a sawtooth signal, principle of generating a triangular signal, principle Triangle-Sine conversion,Square, rectangular, pulse, double pulse signal generators, etc. with practical arrangements using integrated circuits such as: NE555, SN74121, SN74122, SN74123 and logic gates.

Evaluation mode:

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

Bibliographic references:

1. G. Metzger, JP Vabre, "Electronics of impulses", Volume 1, Circuits with localized elements, 3rd edition; Masson, 1985.
2.J.D. Chatelain and R. Dessoulavy, "Electronics", Volumes 1 and 2; Dunod.
3. J. Millman; Microelectronics; Ediscience.
4. S. Boubeker, "Pulse electronics", OPU, 1999.
5. A. Ouahabi, "Corrected electronic problems", Connaissance du monde, 1994.
6. B. Haraoubia, "Operational amplifiers", ENAG Edition, 1994.
7. T. Gervais, "Signal Analysis Tools and Basic Electronic Functions," 2012.
8. J-Ph. Perez, "Electronics: Foundations and Applications", 2012.
9.JP. Cocquerelle, "Switching electronics: circuit analysis", Edition Technip.

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

Teaching objectives:

Learnto the studenthasmaster laboratory measuring devices. Allow him to design and simulate analog and digital electronic circuits. Introduce the student to work in a team on a subject of greater scope than those covered in traditional practical work and with more autonomy. Put the students in a situation close to that which they will have to occupy in the exercise of their profession.

Recommended prior knowledge

The various practical and theoretical lessons taught throughout the Bachelor's course.

Content of the material:

This subject is made up of 3 complementary parts which can be approached in parallel. It is up to the person responsible for the subject to organize the time allocated to this subject to ensure the three themes, namely: Use of measuring devices, Learning of electronic simulation software, Creation of a electronic assembly.

Part A: Use of measuring devices

Before starting to carry out their project, the student can take advantage of this session to consolidate their knowledge in the use of different electronic devices and measure various electrical and electronic quantities, in particular:

- Resistance measurement: measurement outside the circuit and measurement in circuit.
- Measurement of the variation of the resistances of a potentiometer.
- Measurement of capacitors and coils.
- Measurements on a diode.
- Measurement on a diode bridge.
- Measurements on a transistor (conduction test, gain measurement)
- Examples of measurements on some classic transistors and comparisons.
- Measurement on a triac
- Verification of a linear or logic integrated circuit.
- Verification of a programmed component (PROM or EPROM).
- Introduction to the methodology of diagnostics and repair of electronic cards.

(Students can bring in broken electronic cards).

Part B: Learning aElectronics simulation software

This part involves familiarizing the student with the use of simulation software, helping them to move seamlessly from theory to experimentation.

Chapter 1 :Introduction to simulation software (1 week)

Definition of analog simulation in electronics, presentation of the main simulators(PSPICE, TINA,Multisim, Labview, Orcad, Proteus, etc.).

Chapter 2: Presentation of simulation software (5 weeks)

Getting started with specific software, diagram editor (windows, toolbox),stages of schematic entry, define project characteristics and schematics, component libraries, selection and placement of components and terminations, interconnection of components, schematic annotation.
The different types of simulation: temporal analysis, frequency analysis, continuous analysis.
Exploitation of results,display module.

Chapter 3:Digital simulation of projects (5 weeks)
Simulation of different digital circuits (inverter, AND gate, OR gate, astable counter, etc.) and analog circuits (low-pass, high-pass RC filters, amplification by transistors, etc.).

Chapter 4: Measuring instruments (4 weeks)
Use of intuitive measuring instruments (spectrum analyzer, network analyzer, characteristics plotter, etc.),current/voltage/power measurement, tracer of the characteristics of electronic components (diode, JFET transistor; JBT), Bode diagram tracer, spectrum analyzer, network analyzer, logic analyzer, distortion analyzer.

Part C: Creating an electronic assembly
At the end of this subject, it is expected to design and create an application comprising an analog part and/or a digital part which brings together the different electronic functions studied throughout the training.
The mini-projects are carried out by singles, pairs (or possibly trinomials) of students depending on the complexity of the subject.
The student learns to complete a project by going through the different stages: starting from specifications, theoretical design, simulation using software, analysis and comparison of results, possible modification and correction of the circuit, production on a plate. testing, experimentation, measurements, troubleshooting and finally engraving of the final printed circuit.
Writing the corresponding technical file.
An oral defense (or a poster presentation) of the project will be made in front of a jury of teachers (or where applicable, the head of the subject).

Evaluation mode:
Continuous control: 100%.

Bibliographic references:
1. R. Besson, “Electronics with transistors and integrated circuits”, Technique et Vulgarisation, 1979.
2. R. Besson, “Electronic component technology”, Editions Radio.
3. M. Archambault, “Practical training in electronics”, Editions ETSF, 2007.
4. B. Woollard, “Taming the components”, Dunod, 1997.
5. P. Maye, “Electronic components cheat sheet”, Dunod, 2010.
6. P. Mayeux, “Learning electronics through experimentation and simulation”, ETSF, 2006.
7. R. Mallard, “Electronics for Beginners,” Elektor, 2012.
8. JP Oemichen, “Printed circuit technology”, Editions Radio, 1977.
9. JF Pawling, “Surface Mounted Assemblies”, Electrochemical Publications, 1987.

Semester: 6
Teaching unit: UEM 3.2
Subject 2:TP Controls and regulation
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

Consolidate the knowledge acquired on control and regulation through practical work.

Recommended prior knowledge

Controls and regulation, Fundamental electronics 1, Maths 1, 2 and 3.

Content of the material:

TP1: Upgrade for using Matlab toolboxes
Toolbox/Matlab, control and Simulink…

TP2: Modeling of systems in Matlab and functional diagrams.

TP3: Temporal analysis of LTI systems
First and second order and higher order and notion of dominant poles under Matlab and Simulink.

TP4: Frequency analysis of systems
Bode, Nyquist, Black under Matlab and Simulink.

TP5: Stability and precision of servo systems.

TP6: Synthesis of a phase advance corrector, frequency response method.

TP7: Analysis and adjustment of real analog loop systems in the laboratory
Position and speed control, temperature regulation, flow and level regulation.

Evaluation mode:

Continuous control: 100%.

Bibliographic references:

1. K. Ogata, “Modern Control Engineering,” Third Edition; Prentice-Hall Inc., 1997.
2. E. Boillot, “Continuous controls and regulations: Problems with solutions”, 2000.
3. M. Rivoire, JL. Ferrier, “Automatic Exercises”, Volume 2; Edition Chihab-Eyrolles.
4. S.Le Ballois, “Automatic: Linear and continuous systems”, Edition Dunod, 2006.
5. E.Ostertag, “Multivariable control and estimation”, Edition Ellipses, 2006.
6. P. Prouvost, “Control and regulation”, Dunod, 2004.

Semester: 6
Teaching unit: UEM 3.2
Subject 3:TP Sensorsand Instrumentation
VHS: 10:30 p.m. (TP: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

Put into practice the knowledge acquired on the sensors most often used in measurement chains.

Recommended prior knowledge

Sensors and Instrumentation.

Content of the material:

TP1: Presentation of a complete measurement chain (sensor/conditioner).
This practical work can be accomplished either by offering students a visit to an industrial company (Pedagogical Outing), or if necessary, by presenting videos showing the use of sensors in an industrial environment.

TP2: Study of a sensor signal conditioning circuit: Bridge mounting, AOP mounting.

TP3: Temperature measurements: PT 100, Thermocouple, CTN, CTP.

TP4: Speed measurements.

TP5: Position and displacement measurements.

TP6: Force and deformation measurements.

TP7: Pressure, level and flow measurements.

TP8: Vibration measurements.

TP9: Photometric measurements: optics, solar cell or solar panel.

Noticed: Depending on the material available, the person responsible for the subject chooses at least 5 TPs (TPs 1 and 2 + 3 TPs from the non-exhaustive list presented above).

Evaluation mode:

Continuous control: 100%

Bibliographic references:

Semester: 6
Teaching unit: UEM 3.2
Subject 4:TP Power electronics and pulses
VHS: 3:00 p.m. (TP: 1:00 a.m.)
Credits: 1
Coefficient: 1

Teaching objectives:

Know the basic principles of power electronics and the use of power components. Acquire a better knowledge of the main static converters. Generate, using electronic assemblies, different types of pulses by checking their characteristics using oscilloscope measurements. Learn practical methods of generating different types of signals.

Recommended prior knowledge

Power electronics, Pulse electronicss.

Content of the material:

This subject is split into 2 distinct TP units: Power electronics and Pulse electronics. The teacher(s) choose, depending on the teaching equipment, 3 to 4 practical exercises of each unit from the list of practical exercises presented below.

Power electronics practical work:

TP1: Uncontrolled rectifiers: single-phase and three-phase

Analyze the evolution of the voltage and current at the output of the converter with resistive and inductive loads.
Analyze the evolution of the currents and voltages of the semiconductors in both cases of resistive and inductive loads, determine the form factor and the ripple rate.

TP2: Controlled rectifiers: single-phase and three-phase

Analyze the evolution of the voltage and current at the output of the converter with resistive and inductive loads, analyze the evolution of the currents and voltages of the semiconductors in the two cases of resistive and inductive loads, determine the form factor and the ripple rate.

TP3: Choppers: serial chopper, parallel chopper

Study the behavior of a series chopper on the inductive load and in particular determine the shape of the current absorbed by the load during operation in transient then permanent mode, understand the operation by observing the characteristic signals of the assembly and comparing them to the results of the TD on the parallel chopper.

TP4: Dimmers: single-phase and three-phase

Study the operation of a dimmer discharging different types of loads (R and RL) and compare the different results obtained theoretically in class with practical results (formulas and chronograms).

TP5: Inverters: single-phase

Study the operation of single-phase voltage inverters and on the other hand the filtering of the waveforms obtained.

Impulse electronics practical work:

TP1:Integrator circuit and differentiator circuit.

TP2:Limiter circuits.

TP3:Sawtooth signal generator, triangular signal generator.

TP4:Study of an example of a CAN circuit, Study of an example of a DAC circuit.

TP5:Comparators
Creation of bistable circuits based on transistors, operational amplifiers, logic gates and the NE555 circuit.

TP6:The astables
Creation of astable circuits based on transistors, operational amplifiers, logic gates and the NE555 circuit.

TP7:The monostables
Creation of monostable circuits based on transistors, operational amplifiers, logic gates and the NE555 circuit and with the 74121 and 74123 circuits.

TP8:Schmitt trigger threshold circuits
Creation of the Schmitt trigger circuit based on transistors, operational amplifiers, logic gates and the NE555 circuit.

Evaluation mode:
Continuous control: 100%.

Bibliographic references:

Semester: 6
Teaching unit: UED 3.2
Subject 1:Optoelectronic Devices
VHS: 45h00 (Class: 3h00)
Credits: 2
Coefficient: 2

Teaching objectives:

Acquire basic knowledge of optoelectronics. Know optoelectronic components and their uses.

Recommended prior knowledge

Semiconductor 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. Light-semiconductor interaction (1 week)
Properties of light, luminous flux, luminance flux, wave-particle duality of light, spectrum of electromagnetic radiation, different types of light-matter interactions: photo conductivity, photo-ionization, photoelectron, photovoltaics.

Chapter 2. Electronic and optical properties of semiconductors (2 weeks)
Band structure of semiconductors, concepts about energy bands, radiative and non-radiative process in semiconductors, light absorption phenomenon, optoelectronic components: light sensors and detectors.

Chapter 3. Light emitters (4 weeks)
Light-emitting diodes: principle, electrical and spectral characteristics, different types of LED diode, laser diodes: laser oscillation, electrical and spectral characteristics, different types of laser diode.

Chapter 4. Light detectors (4 weeks)
Photoresistor: operation, technology, symbols and coding, diagrams and applications. Photodiode: operation, electrical characteristics, optical characteristics, symbols and coding, associated circuits.
Phototransistor: principle, characteristics, symbols and coding, diagrams and applications.
Photovoltaic cells (Photopile, Solar battery): photovoltaic effect, cell manufacturing. Liquid crystal displays, Photomultiplier, Image sensors.

Chapter 5. Optical fibers (4 weeks)
Introduction, geometric optics, structure of the optical fiber, types of fibers, attenuation, dispersion, operation of optical fibers (wave guidance, parameters, non-linear phenomena), connections and losses in fibers.

Evaluation mode:

Final exam: 100%.

Bibliographic references:

1. E. Rosencher, B. Vinter, «Optoelectronics", CollectionHigher Sciences, 2nd ed.,Dunod, 2002.
2. Z. Toffano, “Optoelectronics: photonic components and optical fibers”, Ellipses, 2001.
3. G. Broussaud, “Optoelectronics”, Edition Masson, 1974.
4. P. Mayé, “Optoelectronicsindustrial: design and applications”, Dunod, 2001.
5. JC.Chaimowicz, “Introduction to optoelectronics principles and implementation”, Dunod.

6. J.M. Wall, “Optical fibers: Fundamental notions”, Epsilon, 2011.
7. D. Decoster, J. Harari, “Detectorsoptoelectronicss”, Lavoisier, 2002.

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: Electronics

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