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

University

LOGO

TRAINING OFFER
L.M.D.

ACADEMIC LICENSE

NATIONAL PROGRAM
2021– 2022

(2nd update)

Establishment	Faculty / Institute	Department

Domain	Course of study	Speciality
Sciences and Technologies	***Automation***	***Automation***

Summary

I – Licence identity sheet

1 - Location of the training:

Faculty (or Institute): Faculty of technology

Department: Electrical Engineering

References of the decree authorising the licence (attach a copy of the decree)

2- External partners:

Other partner institutions:

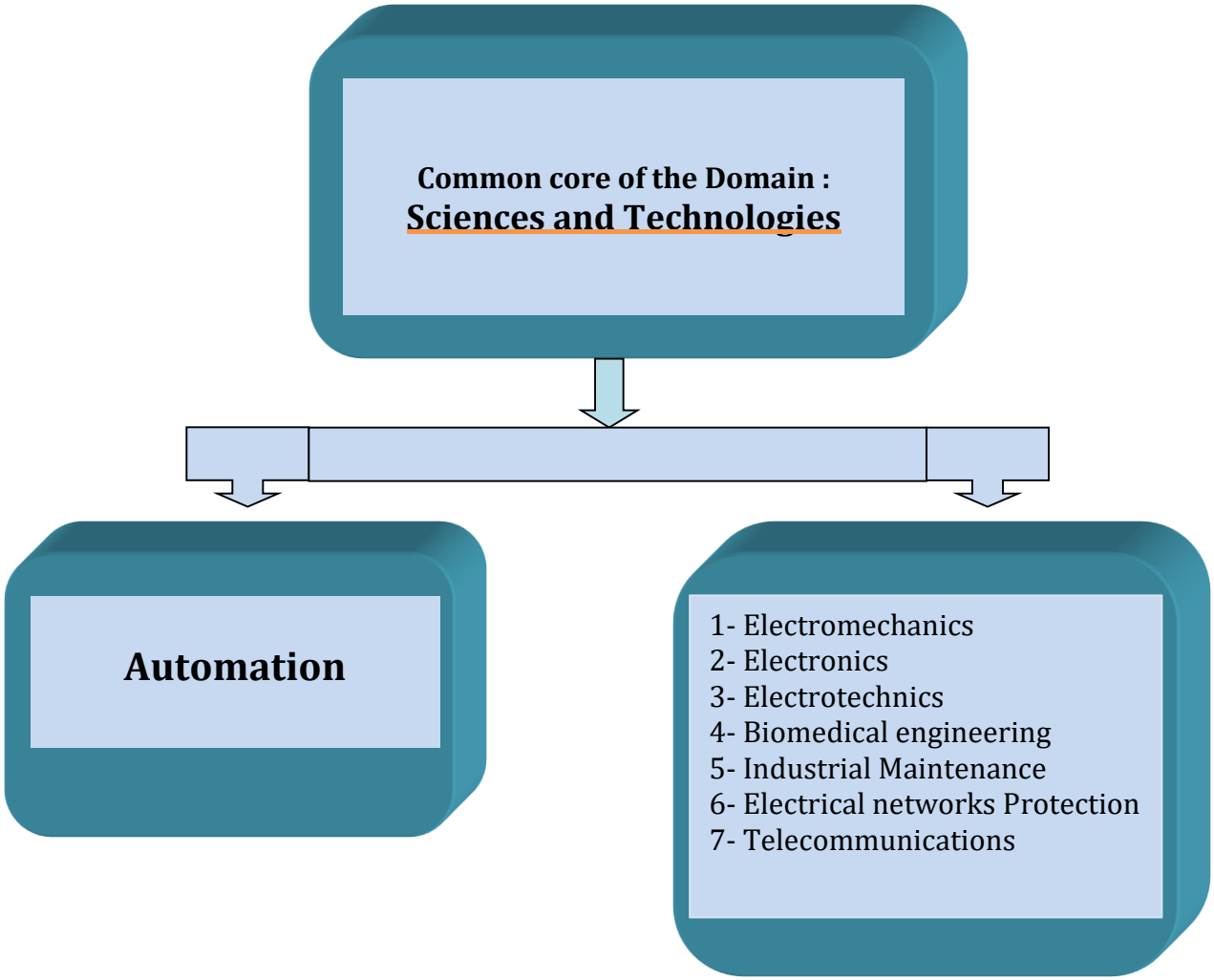
Businesses and other socio-economic partners:

International partners:

3 – Context and objectives of the training

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

Write in the following diagram the Licence that is the subject of this outline as well as all the licences approved (functional or not) at the level of the establishment and belonging to the same Stream Group. Specify with an asterisk any other license that is also supervised by a good part of the teachers involved in this license. Indicate frozen licenses with a double asterisk. Also mark with (P) any professionalizing type license.



B - Objectives of the training:

Automatic control is defined as the science of analyzing and controlling dynamical systems. It is a constantly evolving discipline located at the frontier of many disciplines that give it great importance in terms of applications.

Indeed, modern industry abounds in industrial automation that uses a wide variety of technologies: pneumatics, electromechanics, electronics, electrical engineering, computer science, and others. This is why industrial companies expect the university to train specialists with a multidisciplinary profile and mastery of the tools of IT and industrial control, to put their skills and know-how to the benefit of these sectors. They will then contribute to the efficiency of the company by providing the right information for the right decision.

In this regard, this course in Automation aims to respond exactly to the concerns of industrial partners. Its program is designed to offer students a high-performance diploma program aimed at their smooth integration into the professional sector.

This three-year training is of the academic type. It is largely based on mathematics, physics, electronics, automation and computer science. It is structured in 6 semesters, the first two of which (common core) are reserved for basic subjects (mathematics, physics, chemistry and computer science). From the third semester onwards, the courses become more and more specialized. The student receives the basic knowledge in the field of automation through the mastery of the most widespread control and automation techniques in the various industrial sectors and which can be summarized in three missions: control and supervision of production systems, maintenance of installations, automation of processes (numerical control by programmable logic controllers).

C – Targeted profiles and skills:

The primary purpose of the proposed bachelor's degree is to prepare the student for longer studies (Master's, Doctorate). In addition, the proposed course offers students in difficulty the opportunity to continue their Master's studies to quickly integrate into working life at the end of this training.

They will then be able to act in a wide variety of fields of industry as technical managers for the engineering and industrial maintenance departments of medium or large companies.
The students trained will thus be able to understand a medium-sized automation, to model the control system, to choose the appropriate technologies, to implement classical numerical control algorithms, this in conjunction with (or possibly under the supervision of) a designer working at a higher level of the management of the workshop or production unit.

More concretely, the knowledge acquired by these young executives will essentially allow them to:

- ✓ Integrate effectively into an automation team,
- ✓ Carry out studies, install, operate and repair industrial facilities.
- ✓ Know how to evaluate the performance of a system.
- ✓ Propose and detail the solutions envisaged in collaboration with the engineers.
- ✓ Assist in the definition of project specifications.
- ✓ Ensure the project management.
- ✓ Take into account the socio-economic environment of the company by integrating safety and quality aspects.
- ✓ Assist in the identification of the company's control and command process restructuring needs

D – Regional and national employability potential:

The remarkable evolution of the automated industries in recent years has led to an increased demand for automation executives. Skills in this field are in demand in all branches of industry, regardless of the particular technologies that can be found there. These include:

- ✓ Chemical and petrochemical industries.
- ✓ Iron and steel and metallurgical industries.
- ✓ Mechanical engineering and motor vehicle industries.
- ✓ Hydraulic and seawater desalination industries.
- ✓ Processing, textile and manufacturing industries.
- ✓ Food and beverage industries.
- ✓ Pharmaceutical industries.
- ✓ Building materials industries.
- ✓ Electric power generation and distribution sector.
- ✓ Renewable energy sector.

E – Bridges to other specialties:

Common semesters 1 and 2	
Course of study	**Specialties**
Aeronautics	Aeronautics
Civil engineering	Civil engineering
HVAC Engineering	HVAC Engineering
Marine Engineering	Naval Propulsion and Hydrodynamics
	Shipbuilding and Architecture
Mechanical engineering	Energy
	Mechanical engineering
	Materials Engineering
Hydraulics	Hydraulics
Transportation Engineering	Transportation Engineering
Metallurgy	Metallurgy
Optics and precision mechanics	Optics and photonics
	Precision mechanics
Public works	Public works
Automation	Automation
Electromechanics	Electromechanics
	Industrial maintenance
Electronics	Electronics
Electrotechnical	Electrotechnical
Biomedical Engineering	Biomedical Engineering
Industrial Engineering	Industrial Engineering
Telecommunication	Telecommunication
Process Engineering	Process Engineering
Mining Engineering	Mining
	Mineral resource development
Hydrocarbons	Hydrocarbons
Industrial Health and Safety	Industrial Health and Safety
Petrochemical industries	Refining and petrochemicals

Table of courses and specialties in the field of Science and Technology

Course of study group A Semester 3 common	
Course of study	**Specialties**
Automation	Automation
Electromechanics	Electromechanics
	Industrial maintenance
Electronics	Electronics
Electrotechnical	Electrotechnical
Biomedical Engineering	Biomedical Engineering
Industrial Engineering	Industrial Engineering
Telecommunication	Telecommunication

Course of study group B Semester 3 common	
Course of study	**Specialties**
Aeronautics	Aeronautics
Civil engineering	Civil engineering
HVAC Engineering	HVAC Engineering
Marine Engineering	Naval Propulsion and Hydrodynamics
	Shipbuilding and Architecture
Mechanical engineering	Energy
	Mechanical engineering
	Materials Engineering
Hydraulics	Hydraulics
Transportation Engineering	Transportation Engineering
Metallurgy	Metallurgy
Optics and precision mechanics	Optics and photonics
	Precision mechanics
Public works	Public works

Course of study group C Semester 3 common	
Course of study	**Speciality**
Process Engineering	Process Engineering
Mining Engineering	Mining
	Mineral resource development
Hydrocarbons	Hydrocarbons
Industrial Health and Safety	Industrial Health and Safety
Petrochemical industries	Refining and petrochemicals

The courses that present common basic courses (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 bachelor's degree offers multidisciplinary and transversal teaching programs:

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

Semester	Course study 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 Bachelor's degree offers the student the choice to join, if he or she expresses the desire and depending on the teaching places available:

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

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

- All the specialties of another group of courses at the end of semester 3 (Subject to equivalence and the opinion of the training team).

- All specialties of the same group of courses at the end of semester 4 (Subject to equivalence and the opinion of the training team).

F – Performance indicators expected from the training:

All training must meet the quality requirements of today and tomorrow. As such, in order to better appreciate the expected performance of the proposed training on the one hand and by exploiting the flexibility and flexibility of the LMD system on the other hand, a certain number of mechanisms are proposed, for this bachelor's degree, to evaluate and monitor the progress of teaching, the training programs, student/teacher and student/administration relations, the future of the graduates of this bachelor's degree as well as the assessments of the university's partners as to the quality of the graduates recruited and/or the courses 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-the-job monitoring of students in training and surveys of recruited graduates and their employers. To do this, a report must be drawn up, archived and widely disseminated.

1. Evaluation of the course of the training:

In addition to the regular meetings of the Pedagogical Committee, a meeting at the end of each semester is organized. It brings together teachers and students from the class 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 of the indicators and methods envisaged for the evaluation and monitoring of this training project by the pedagogical committee is proposed:

Prior to the training:

- ✓ Evolution of the rate of students who have chosen this Bachelor's degree (SUPPLY/DEMAND RATIO).
- ✓ Rate and quality of students who choose this bachelor's degree.

During the training:

- ✓ Regularity of the meetings of the pedagogical committees.
- ✓ Conformity 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 teaching and teaching methods.

Downstream of the training:

- ✓ Student success rate per semester in this Bachelor's degree.
- ✓ Student attrition rate (failures and dropouts).
- ✓ Identification of the causes of student failure.
- ✓ Alternative reorientation is offered to students in a situation of failure.
- ✓ Rate of students graduating on time.
- ✓ Rate of students who continue their studies after the bachelor's degree.

2. Evaluation of the course of the teaching:

The courses in this course are subject to regular evaluation (once a year) by the training team which will, on request, be made available to the various institutions: National Pedagogical Committee of the Field of Science and Technology, Regional Conferences, Vice-Rector's Office in charge of pedagogy, Faculty, etc.

As a result, a system for evaluating curricula and teaching methods can be set up based on the following indicators:

- ✓ Equipment of educational rooms and laboratories with the materials and supports necessary for pedagogical 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 solved.
- ✓ Equipment of educational laboratories with materials and equipment in line with the content of the teaching.
- ✓ Number of weeks of actual teaching provided during a semester.

- ✓ Rate of completion of teaching programmes.
- ✓ Digitization and conservation of end-of-studies and/or end-of-cycle dissertations.
- ✓ Number of practical exercises carried out as well as the multiplication of the type of practical work by subject (diversity of practical work).
- ✓ Quality of the institution's documentary collection in relation to the specialty and its accessibility.
- ✓ Support from the socio-economic sector for training (company visits, internships, seminars given by professionals, etc.).

3. Integration of graduates:

A coordination committee, composed of those in charge of training and members of the Administration, is set up, which is mainly responsible for monitoring the integration of graduates in the sector into professional life, setting up a file for monitoring graduates in the sector, identifying and/or updating the existing economic and industrial potential at regional and national level, to anticipate and encourage new professions in relation to the sector in association with the Chamber of Commerce, the various employment support agencies, public and private operators, etc., to participate in any action concerning the professional integration of graduates (organisation of events with socio-economic operators).
To carry out these missions, this committee has all the latitude to carry out or commission any study or survey on the employment and post-employment of graduates. The following is a list of indicators and modalities that could be considered to evaluate and monitor this operation:

- ✓ Rate of recruitment of graduates in the socio-economic sector in a position directly related to training.
- ✓ Nature of the jobs held by graduates.
- ✓ Diversity of opportunities.
- ✓ Installation of an association of former graduates of the sector.
- ✓ Creation of small businesses by graduates of the specialty.
- ✓ Degree of employer satisfaction.

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

G1- Evaluation by continuous assessment:

The importance of continuous assessment methods on the training of students in terms of pedagogical achievements is no longer to be demonstrated. In this regard, Articles 20, 21 and 22 of Decree 712 of 3 November 2011 define and specify the modalities and organization of the continuous evaluation of students according to the training course. The calculation of the averages of the continuous assessment (tutorials and practical work) is done from a weighting of all the elements that make up this evaluation. These articles specify that this weighting is left to the discretion of the teaching team.

A survey conducted by the CPND-ST among all teachers in the different university institutions showed heterogeneity in the implementation of continuous student evaluation. Also, we are led to admit a real deficit in the effective management of this educational activity, which has required serious reflection on this subject on our part which, combined with the proposals coming from several schools, has led to the recommendations below.

The analysis of the various proposals from these establishments has shown that Articles 21 and 22 of Decree 712 of 3 November 2011 are not explicit enough and deserve more clarification.

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

1. Proposals relating to subjects with tutorials:

1.1. Preparation of the series of exercises:

The teacher in charge of the subject must organize himself by proposing a series of exercises for each chapter of the course. This series must be exhaustive with exercises to understand the course and standard exercises to be solved in a tutorial session.

These exercises must be prepared by the student before coming to the tutorial. This preparation can be evaluated. The evaluation method is left to the discretion of the teacher in charge of the tutorial.

Exercises not solved in tutorials can be the subject of personal work to be completed by groups of 3 to 4 students and submitted for evaluation (deadline: 1 week).

1.2. Written questions:

Each end of the series of exercises (*i.e.* each end of the chapter) will be sanctioned by a short written question. This examination must be organised in collaboration with the person in charge of the subject in order to ensure a fair evaluation with regard to all students (mainly when several teachers are involved in the tutorials).

1.3. Participation of students in tutorials:

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

1.4. Student attendance:

Student attendance is mandatory in tutorials and practical work. In class, it is difficult to control it for undergraduate students where the number of students is very large (lectures in the lecture hall). For master's degrees where the number of students is small, attendance must be compulsory in classes and in 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 test to control this preparation must be organised by the teacher before each manipulation (in the form of small comprehension questions, MCQs, diagram of the manipulation, etc.). A report (by working group) must be submitted at the end of the practical work session. As such, the teacher must prepare a standard report (outline) to facilitate the work for the students so that they can actually submit it at the end of the practical session.

At the end of the semester, the teacher organizes a practical test that summarizes all the manipulations carried out by the student.

3. About transversal and discovery subjects that do not have a tutorial or practical work:

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

Nevertheless, the teacher in charge of this subject may, if he wishes, let the students know that he can possibly evaluate them (continuously) by proposing that they prepare presentations, make reports, look for the complement of the course, use free software, ask the students to watch at home a popular science film related to the subject (after having given them either the film on electronic media or having 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, who are the only ones able to define the best way to take this personal work into account in the overall mark of the final exam.

In the same vein, and in the event that the number of students in this subject is reasonable (20 to 30 students), which may be the case for many master's degrees, the subject supervisor may consider continuous evaluations of the student similar to what is done in subjects with tutorials. The only obligation to be respected is that students should be informed of this procedure and validated during the first Pedagogical Council.

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

4. Harmonization of continuous assessment:

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 institution 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 that presents the different continuous assessments that make it possible to assess the degree of acquisition of students' skills, whether in terms of knowledge, analytical skills and synthesis skills.
It should be noted that these evaluations are not intended to "trap" students by imposing very difficult continuous assessments on them. On the contrary, it is a question of evaluating "honestly" the degree of assimilation of the different skills and knowledge taught to the student in all objectivity. In the same spirit, we would benefit from promoting the contractualization of learning assessment by specifying, for example, the success criteria and good practices that would lead to correct and precise answers to the questions. Thus, the evaluation would mainly focus on the acquired knowledge that has been the subject of training by giving exercises related to what has been prepared in the tutorials, without forgetting, however, to evaluate the students' ability to mobilize their skills in more complex situations.

4-1 Tutorials:

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

4.2 Practical work:

Practical work preparation tests	20%	04 points
Report (to be submitted at the end of the practical session)	40%	08 points

Practical work test at the end of the semester on all the manipulations carried out by the student.	40%	08 points
Total	**100%**	**20 points**

G2- The student's personal work:

The student's personal work is part of the spirit of the LMD. It has been reserved for a very substantial weekly time: about 50% of the total hourly volume of the training (see the table "Global summary of the training" present in this training offer).

A survey carried out by the CPND-ST among training teams across all university institutions indicated that the time related to the student's personal work could be judiciously used, under the good supervision of the teacher, in a rational way and in different forms. The tasks that would then be completed by the student volunteers would be evaluated and counted (as a bonus) in their overall grade of the continuous assessment. The rate of this bonus is left to the free will of the teaching teams.

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

1. Homework:

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

2. Mini Class 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 concretize through practice the techniques learned in transversal subjects. It also allows him to develop the spirit of working in a group.

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 an audio-visual support). A mark, common to the group, is awarded according to an evaluation grid (presentation of the document and use of bibliographic resources, oral presentation, respect for time, answers to questions, etc.) and will then be counted, as a bonus, in the continuous assessment mark.

3. Report on a visit, a field trip or a discovery and/or impregnation course:

Visits, educational outings, discovery and/or immersion internships are opportunities for students likely to allow them to better understand the reality of the world of work and later help them to better integrate into the workforce.

Administrative managers and teachers must encourage, as much as possible, this very important aspect of training and ensure the organization of visits and educational outings throughout the training course.

They must also help/encourage students to prospect in economic institutions in order to find (in L3 and M1) one- to two-week discovery and/or immersion internships in the industrial environment during the winter and spring holidays.

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

4. Participation in scientific events:

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

5. Use of New Information and Communication Technologies:

The new information and communication technologies are very attractive to 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 will also be able to intervene in the group as an online evaluator. This activity can be evaluated, graded and registered as a bonus to students who get involved.

Conclusion:

The autonomy of the student, considered as a lever for success, is largely based on the personal work that he or she is required to do, by appropriating the resources and tools at his or her disposal. All this must, of course, be supervised and formalized within the framework of the pedagogical follow-up and support that must be provided jointly by the university teacher and the administrative manager throughout his or her training course.

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

4 - Available human resources:

A: Leadership Capacity (expressed in terms of the number of students that can be supported):

Number of students:

B: Internal teaching team mobilized for the specialty: (To be filled in and approved by the faculty or institute)

Name and surname	Graduation Diploma	Specialty degree (Magister, PhD)	Rank	Subjects to be taught	Signing in

Department visa **Visa from the faculty or institute**

C: External teaching team mobilized for the specialty:(To be filled in and approved by the faculty or institute)

Name and surname	Establishment to which the company is attached	Graduation Diploma	Specialty degree (Magister, PhD)	Rank	Subjects to be taught	Signing in

Department visa

Visa from the faculty or institute

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

Rank	Internal Workforce	External Workforce	Total
Teachers			
Associate Professors (A)			
Associate Professors (B)			
Assistant Lecturer (A)			
Assistant Lecturer (B)			
Other (*)			
Total			

(*) Technical and support staff

5 - Material resources specific to the specialty

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

Title of the laboratory:

Student Capacity:

No.	Equipment Designation	Number	Comments

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

Location of the internship	Number of students	Duration of the internship

C- Documentation available at the level of the institution specific to the proposed training (Mandatory field):

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

II – Semester organisation sheets for teaching of the specialty

Semester 1

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
	Entitled			**Course**	**Tutorial**	**Lab**			**Continuous assessment**	**Examination**
Core UE Code: UEF 1.1 Credits: 18 Coefficients: 9	Mathematics 1	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
	Physics 1	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
	Structure of matter	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
Methodological UE Code: EMU 1.1 Credits: 9 Coefficients: 5	Physics 1 -Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Chemistry1- Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Computer Science 1	4	2	1h30		1h30	45h00	55:00 pm	40%	60%
	Writing methodology	1	1	1h00			3:00 p.m.	10:00 a.m.		100%
Discovery UE Code: UED 1.1 Credits: 1 Coefficients: 1	Careers in Science and Technologies 1	1	1	1h30			10:30 p.m.	02:30 am		100%
E Transversal Code: UET 1.1 Credits: 2 Coefficients: 2	Ethical and deontological	1	1	1h30			10:30 p.m.	02:30 am		100%

	dimension (the foundations)									
	Foreign Language 1 (French or English)	1	1	1h30			10:30 p.m.	02:30 am		100 %
Semester 1 total		**30**	**17**	**4:00 p.m.**	**4h30**	**4h30**	**375h00**	**375h00**		

Semester 2

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
	Entitled			**Lecture**	**Tutorial**	**Lab**			**Continuous assessment**	**Examination**
Core UE Code: UEF 1.2 Credits: 18 Coefficients: 9	Mathematics 2	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
	Physics 2	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
	Thermodynamics	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
Methodological UE Code: EMU 1.2 Credits: 9	Physics 2 Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Chemistry 2 Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	

Coefficients: 5	Computer Science 2	4	2	1h30		1h30	45h00	55:00 pm	40%	60%
	Presentation Methodology	1	1	1h00			3:00 p.m.	10:00 a.m.		100%
Discovery UE Code: UED 1.2 Credits: 1 Coefficients: 1	Careers in Science and Technologies 2	1	1	1h30			10:30 p.m.	02:30 am		100%
Transversal UE Code: UET 1.2 Credits: 2 Coefficients: 2	Foreign Language 2 (French and/or English)	2	2	3:00 pm			45h00	05:00		100 %
Semester 2 total		**30**	**17**	**4:00 p.m.**	**4h30**	**4h30**	**375h00**	**375h00**		

Semester 3

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
	Entitled			**Lecture**	**Tutorial**	**Lab**			**Continuous assessment**	**Examination**
Core UE Code: UEF 2.1.1 Credits: 10 Coefficients: 5	Mathematics 3	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
	Waves and vibrations	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
Core UE Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Fundamental Electronics 1	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
	Basic Electrical Engineering 1	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
Methodological UE Code: EMU 2.1 Credits: 9 Coefficients: 5	Probability and statistics	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
	Computer science3- Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Electronics and Electrical Engineering- Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Waves and Vibrations- Lab Course	1	1			1h00	3:00 p.m.	10:00 a.m.	100%	

Discovery UE Code: UED 2.1 Credits: 2 Coefficients: 2	State of the art of electrical engineering	1	1	1h30			10:30 p.m.	02:30 am		100%
	Energy and environment	1	1	1h30			10:30 p.m.	02:30 am		100%
Transversal UE Code: UET 2.1 Credits: 1 Coefficients: 1	Technical English	1	1	1h30			10:30 p.m.	02:30 am		100%
Semester 3 total		**30**	**17**	**1:30 p.m.**	**7:30 a.m.**	**4:00 pm**	**375h00**	**375h00**		

Semester 4

Teaching unit	Entitled	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
				Lecture	**Tutorial**	**Lab**			**Continuous assessment**	**Examination**
Core UE Code: UEF 2.2.1 Credits: 10 Coefficients: 5	Linear and continuous feedback control systems	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
	Combinatorial and sequential logic	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
Core UE Code: UEF 2.2.2 Credits: 8	Numerical methods	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
	Signal theory	4	2	1h30	1h30		45h00	55:00 pm	40%	60%

Coefficients: 4										
Methodological UE Code: EMU 2.2 Credits: 9 Coefficients: 5	Electrical measurements and electronics- Lab Course	3	2	1h30		1h00	37:30 p.m.	37:30 p.m.	40%	60%
	Linear and Continuous feedback control systems - Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Combinatorial and sequential Logic- Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Numerical methods - Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
Discovery UE Code: UED 2.2 Credits: 2 Coefficients: 2	Automated Systems Architecture	1	1	1h30			10:30 p.m.	02:30 am		100%
	Electrical safety	1	1	1h30			10:30 p.m.	02:30 am		100%
Transversal UE Code: UET 2.2 Credits: 1 Coefficients: 1	Information and communication techniques	1	1	1h30			10:30 p.m.	02:30 am		100%
Total Semester 4		**30**	**17**	**1:30 p.m.**	**6:00 pm**	**5:30 a.m.**	**375h00**	**375h00**		

Semester 5

Teaching unit	Entitled	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
				Lecture	**Tutorial**	**Lab**			**Continuous assessment**	**Examination**
Core UE Code: UEF 3.1.1 Credits: 10 Coefficients: 5	Linear System Control	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
	Power Electronics	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
	Modeling and identification of systems	2	1	1h30			10:30 p.m.	27:30		100%
Core UE Code: UEF 3.1.2 Credits: 8 Coefficients: 4	Microprocessors and Microcontrollers	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
	C++ programming	2	1	1h30			10:30 p.m.	27:30		100%
Methodological UE Code: EMU 3.1 Credits: 9 Coefficients: 5	Linear System Control -Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Power Electronics -Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Modeling and Identification of Systems- Lab Course	2	1			1h30	10:30 p.m.	27:30	100%	
	Microprocessors and Micro-	2	1			1h30	10:30 p.m.	27:30	100%	

	Controllers- Lab Course									
	programming in C++ Lab Course	1	1			1h00	3:00 p.m.	10:00 a.m.	100%	
Discovery UE Code: UED 3.1 Credits: 2 Coefficients: 2	Standards & Certification	1	1	1h30			10:30 p.m.	02:30 am		100%
	Renewable energies: Production and storage	1	1	1h30			10:30 p.m.	02:30 am		100%
Transversal UE Code: UET 3.1 Credits: 1 Coefficients: 1	English in Automatic	1	1	1h30			10:30 p.m.	02:30 am		100%
Total Semester 5		**30**	**17**	**1:30 p.m.**	**4h30**	**7:00 pm**	**375h00**	**375h00**		

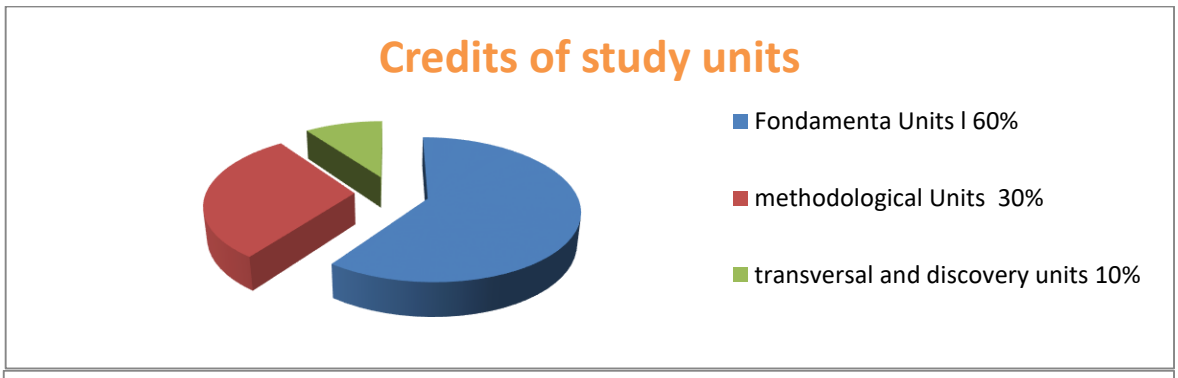
Semester 6

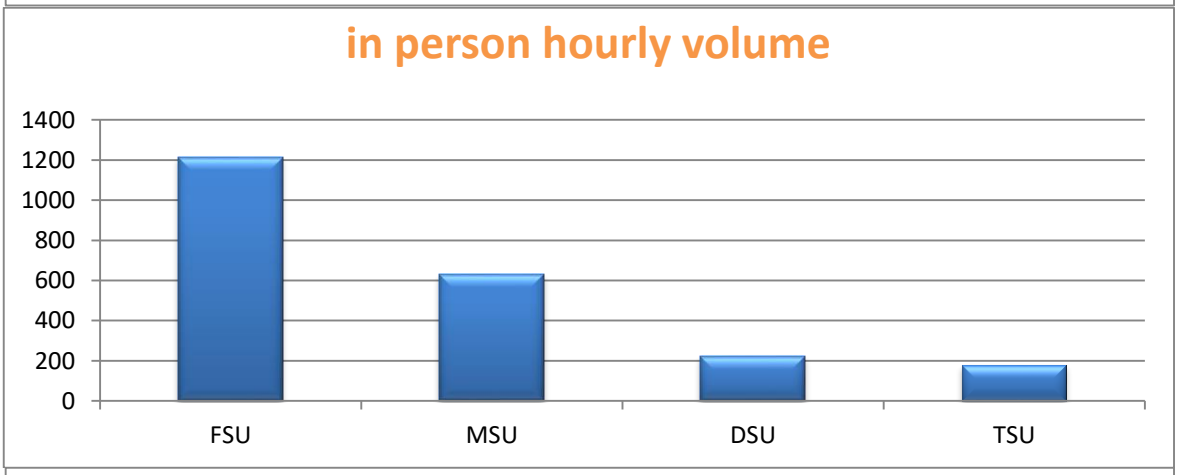
Teaching unit	Entitled	Credits	Coefficient	Weekly hourly volume			Semi-Annual Hourly Volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation method	
				Lecture	**Tutorial**	**Lab**			**Continuous assessment**	**Examination**
Core UE Code: UEF 3.2.1 Credits: 10 Coefficients: 5	Discrete-time control systems	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
	Actuators	4	2	1h30	1h30		45h00	55:00 pm	40%	60%
	Sensors and measurement chains	2	1	1h30			10:30 p.m.	27:30		100%
Core UE Code: UEF 3.2.2 Credits: 8 Coefficients: 4	Industrial programmable logic controllers	6	3	3:00 pm	1h30		67h30	82:30 p.m.	40%	60%
	Communication Buses and Industrial Networks	2	1	1h30			10:30 p.m.	27:30		100%
Methodological UE Code: EMU 3.2 Credits: 9 Coefficients: 5	End of Cycle Project - Lab course	4	2			3:00 pm	45h00	55:00 pm	100%	
	Sensors and Actuators- Lab course	2	1			1h30	10:30 p.m.	27:30	100%	
	Industrial Programmable Logic Controllers -Lab course	2	1			1h30	10:30 p.m.	27:30	100%	
	Communication Buses and	1	1			1h00	3:00 p.m.	10:00 a.m.	100%	

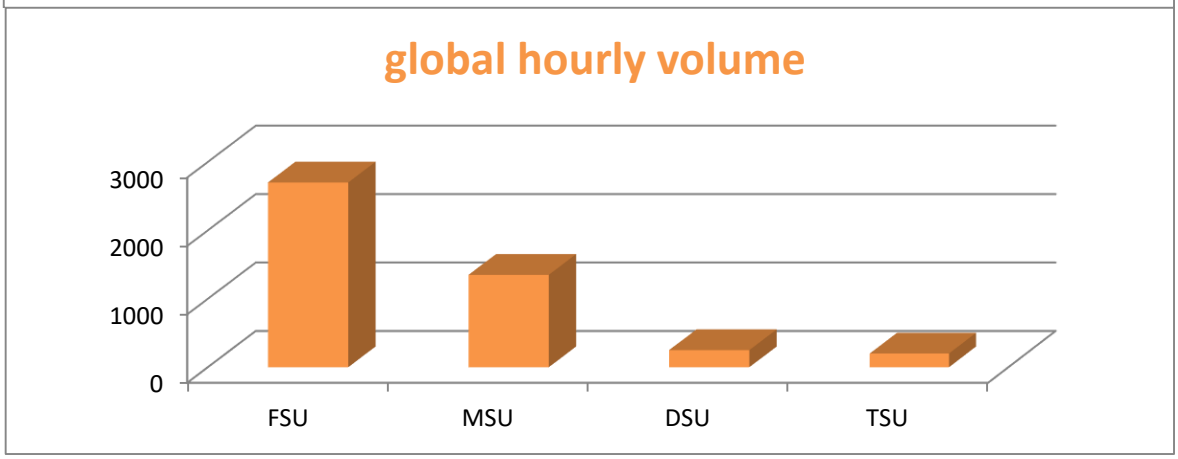
	Industrial Networks- Lab course									
Discovery UE Code: UED 3.2 Credits: 2 Coefficients: 2	Automatic electrical installations	1	1	1h30			10:30 p.m.	02:30 am		100%
	Maintenance and reliability	1	1	1h30			10:30 p.m.	02:30 am		100%
Transversal UE Code: UET 3.2 Credits: 1 Coefficients: 1	Entrepreneurship and business management	1	1	1h30			10:30 p.m.	02:30 am		100%
Semester Total 6		**30**	**17**	**1:30 p.m.**	**4h30**	**7:00 pm**	**375h00**	**375h00**		

Overall summary of the training:

EU / VH	UEF	EMU	UED	UET	Total
Lecture	720h00	120:00 pm	225h00	180h00	1245h00
Tutorial	495h00	10:30 p.m.	---	---	517h30
practical work	---	487h30	---	---	487h30
Personal work	1485h00	720h00	25:00	8:00 p.m.	2250h00
Other (specify)	---	---	---	---	---
Total	2700h00	1350h00	250h00	200h00	4500h00
Credits	108	54	10	8	180
% in credits for each UE	60 %	30 %	10 %		100 %







III - Detailed programme by subject

Semester: 1
Teaching unit: UEF 1.1
Subject 1: Mathematics 1
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

This first subject of mathematics is devoted in particular to the homogenization of the level of students at the entrance to university. The first new elements are taught in a progressive way in order to lead students towards more advanced mathematics. The concepts covered in this subject are fundamental and among the most used in the field of Science and Technology.

Recommended Prior Knowledge

Basic notions of mathematics in the final year of high school (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 by the absurd. 1-4 Reasoning on the other hand, example. 1-5 Reasoning by recurrence.

Chapter 2. Sets, Relationships, and Applications (2 weeks)
2.1 Set theory. 2-2 Relation of order, relations of equivalence. 2-3 Injective, surjective, bijective map: definition of an map, direct image, reciprocal image, characteristic of an map.

Chapter 3. Real functions to 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's 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 mapping, kernel, image, rank.

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

References:

1- K. Allab, Elements of analysis, Function of a real variable, 1st & 2nd years of university, Office des Publications universitaires.
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, Exercices d'algèbre, 1st scientific cycle preparation for the grandes écoles 2nd year, Armand Colin – Collection U.

6- J. Quinet, Cours élémentaire de mathématiques supérieures 1- Algèbre, Dunod.
7- J. Quinet, Cours élémentaire de mathématiques supérieures 2- Fonctions usuelles, Dunod.
8- J. Quinet, Cours élémentaire de mathématiques supérieures 3- Calculus intégrale et séries, Dunod.
9- J. Quinet, Cours élémentaire de mathématiques supérieures 4- Equations différentielles, Dunod.

Semester: 1
Teaching unit: UEF 1.1
Subject 2: Physics 1
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

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

Recommended Prior Knowledge

Notions of mathematics and physics.

Material content:

Math reminders (2 weeks)

1- Equations with dimensions
2- Vector calculus: dot product (norm), vector product, multivariate functions, differentiation. Vector analysis: gradient, rotational, ...

Chapter 1. Kinematics (5 weeks)

1- Position vector in coordinate systems (Cartesian, cylindrical, spherical, curvilinear)- Law of motion - Trajectory. 2- Velocity and acceleration in coordinate systems. 3- Applications: Material point motion in different coordinate systems. 4- Relative motion.

Chapter 2. Dynamic: (4 weeks)

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

Chapter 3. Work and energy (4 weeks)

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

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. Has. Gibaud, M. Henry ; Physics course - Point mechanics - Corrected courses and exercises; Dunod, 2007.
2. P. Fishbane et al.; Physics For Scientists and Engineers with Modern Physics, 3rd Ed.; 2005.
3. P. A. Tipler, G. Mosca; Physics For Scientists and Engineers, 6th Ed., W. H. Freeman Company, 2008.

Semester: 1
Teaching unit: UEF 1.1
Matter 3: Structure of Matter
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

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

Recommended Prior Knowledge

Basic notions of mathematics and general chemistry.

Material content:

Chapter 1: Basics (2 weeks)

Macroscopic states and characteristics of states of matter, changes in states of matter, notions of atom, molecule, mole and Avogadro number, unit of atomic mass, 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 the material (3 weeks)

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

Chapter 3: Radioactivity – Nuclear Reactions (2 weeks)

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

Chapter 4: Electronic structure of the atom (2 weeks)

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

Chapter 5: Periodic Classification of Elements (3 weeks)

D. Mendeleev's periodic classification, Modern periodic classification, Evolution and periodicity of the physico-chemical properties of the elements, Calculation of rays (atomic and ionic), successive ionization energies, electron affinity and electronegativity (Mulliken's scale) by Slater's rules.

Chapter 6: Chemical Bonds (3 weeks)

Covalent bonding in Lewis theory, Polarized covalent bonding, dipole moment and partial ionic character of bonding, Geometry of molecules: Gillespie's theory or VSEPR, Chemical bonding in the quantum model.

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

References

1. Ouahes, Devallez, Chimie Générale, OPU.
2. S.S. Zumdhal & 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, Cours de Chimie Physique, Ed. Dunod.
7. M. Guymont, Structure de la matière, Belin Coll., 2003.
8. G. Devore, Chimie générale: T1, étude des structures, Coll. Vuibert, 1980.
9. M. Karapetiantz, Constitution de la matière, Ed. Mir, 1980.

Semester: 1
Teaching Unit: UEM 1.1
Subject 1: Physics1 Lab Course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended Prior Knowledge

Notions of mathematics and physics.

Material content:

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

- Methodology for presenting practical work reports and calculating errors.
- Verification of Newton's 2nd law
-Freefall
- Single pendulum
- Elastic collisions
- Inelastic collisions
- Moment of inertia
-Centrifugal force

Evaluation method:

Continuous assessment: 100%.

Semester: 1
Teaching Unit: UEM 1.1
Subject 2: Chemistry 1 - Lab Course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended Prior Knowledge

Basic Chemistry Concepts.

Material content:

1. Safety in the laboratory

2. Preparation of solutions

3. Notions of uncertainty calculations applied to chemistry.

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

5. Acid-base dosing by conductivity meter.

5. Oxidation-reduction dosage

6. Determination of water hardness

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

Evaluation method:

Continuous Assessment: 100%

Semester: 1
Teaching Unit: UEM 1.1
Subject 3: Computer Science 1
VHS: 45h00 (Lecture: 1h30, Lab Session: 1h30)
Credits: 4
Coefficient: 2

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

Recommended Prior Knowledge
Basics of Web technology.

Material content:
Part 1. Introduction to Computer Science (5 weeks)
1- Definition of computer science
2- Evolution of computers and computers
3- Information coding systems
4- How a computer works
5- Hardware part of a computer
6- System part
Basic systems (operating systems (Windows, Linux, Mac OS,...)
Programming languages, application software

Part 2. Notions of algorithm and program (10 weeks)
1- Concept of an algorithm
2- Representation in organizational chart
3- Structure of a program
4- The approach and analysis of a problem
5- Data structure: Constants and variables, Data types
6- Operators: assignment operator, relational operators, logical operators, arithmetic operations, priorities in operations
7- Entry/exit operations
8- Control structures: Conditional control structures, Repetitive control structures

Computer Science 1 :
The purpose of the practical work is to illustrate the concepts taught during the course. The latter must start with the courses according to the following schedule:
• Practical work to introduce and familiarize yourself with the computer machine from a hardware and operating system point of view (exploration of the different functionalities of OS)
• Practical work to learn how to use a programming environment (Editing, Assembly, Compilation, etc.)
• Practical work of applying the programming techniques seen in class.

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

References
1- John Paul Mueller and Luca Massaron, Algorithms for Dummies in Large Format, 2017.
2- Charles E. Leiserson, Clifford Stein and Thomas H. Cormen, Algorithmics: Courses with 957 Exercises and 158 Problems, 2017.
3- Thomas H. Cormen, Algorithms: Basics, 2013.

Semester: 1
Teaching Unit: UEM 1.1
Subject 4: Writing methodology
VHS: 15:00 (Lecture: 1:00 am)
Credits: 1
Coefficient: 1

Teaching objectives

Familiarize and train students in the current concepts of writing methodology in force in the Science and Technology profession. Among the skills to be acquired: Knowing how to present oneself; Know how to write a CV and a cover letter; Know how to position oneself 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 an abstract, a letter, an application

Chapter 2. Information retrieval, synthesis and exploitation (3 weeks)
- Search for information in libraries (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
- The length of sentences
- Division into paragraphs
- The use of a neutral style and third-person writing
- Legibility
- Objectivity
- Intellectual rigor and plagiarism

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

Chapter 5. Applications (3 weeks)
Report on a practical work

Evaluation method:

Exam Control: 100%.

References:

1. J.-L. Lebrun, Guide pratique de rédaction scientifique, EDP Sciences, 2007.
2. M. Fayet, Réussir ses comptes rendus, 3rd edition, Eyrolles, 2009.
3. M. Kalika, Master's thesis - Piloting a dissertation, Writing a report, Preparing a defense, Dunod, 2016.
4. M. Greuter, Réussir son mémoire et son rapport de placement, 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, Le grand livre des modèles de lettres, Eyrolles, 2012.

8. R. Barrass, Scientist must write – A guide to better writing for scientists, engineers and students, 2d edition, Routledge, 2002.
9. G. Andreani, La pratique de la correspondance, Hachette, 1995.
10. Ph. Rubens, Science & Technical Writing, A Manual of Style, 2d edition, Routledge, 2001.
11. A. Wallwork, User Guides, Manuals, and Technical Writing – A Guide to Professional English, Springer, 2014.

Semester: 1
Teaching unit: UED 1.1
Subject 1: Careers in Science and Technology 1
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Purpose of the material:
In the first stage, the student will be introduced to all the courses that are covered by the Science and Technology Field, and in the second stage, a wide range of professions to which these courses lead. In the same context, this subject introduces the new challenges of sustainable development as well as the new professions that can result from it.

Recommended Prior Knowledge
No.

Content of the material:

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

2. Courses in Electronics, Telecommunications, Biomedical Engineering, Electrical Engineering, Electromechanics, Optics & Precision Mechanics: (2 weeks)
- Definitions, fields of application (Home automation, embedded applications for automotive, Video surveillance, Mobile telephony, Fiber optics, Advanced scientific instrumentation, Imaging and medical instrumentation , Giant mirrors, Contact lenses, Transmission and Distribution of electrical energy, Power generation plants, Energy efficiency, Maintenance of industrial equipment, Elevators, Wind turbines, ...
- Role of the specialist in these areas.

3. Automation and Industrial Engineering courses: (1 week)
- Definitions, fields of application (Industrial Automated Lines, Numerical Control Machine Tools, Robotics, Inventory Management, Goods Traffic Management, Quality, - Role of the specialist in these fields.

4. Process Engineering, Hydrocarbons and Petrochemical Industries: (2 weeks)
- Definitions, Pharmaceutical industry, Food industry, Leather and textile industry, Biotechnology, Chemical and petrochemical industry, Plastics processing, 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, ...), Biodiversity loss, ...), SD diagram (Sustainable = Viable + Liveable + Equitable), SD actors (governments, citizens, socio-economic sector, international organizations...), Global nature of SD challenges

6. Sustainable engineering: (4 weeks)
Definition, Principles of sustainable engineering (definitions of: sustainable energy/energy efficiency, sustainable mobility/ecomobility, resource recovery (water, metals and minerals, ...), sustainable production), Relevance of sustainable engineering in ST sectors, Relationship between sustainability and engineering, Responsibility of engineers in the implementation of sustainable projects, ...

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

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

Method of evaluation:
100% Review

References:
1- What jobs for tomorrow? Publisher: ONISEP, 2016, Collection: Les Dossiers.
2- J. Douënel and I. Sédès, Choisir un métier selon son profil, Editions d'Organisation, Collection: Emploi & carrière, 2010.
3- V. Bertereau and E. Ratière, What job are you made for? Publisher: L'Étudiant, 6th edition, Collection: Métiers, 2015.
4- The Big Book of Trades, Publisher: L'Étudiant, Collection: Métiers, 2017.
5- Careers in the aeronautics and space industry, Collection: Parcours, Edition: ONISEP, 2017.
6- Electronics and robotics professions, Collection: Parcours, Edition: ONISEP, 2015.
7- Les métiers de l'environnement et du développement durable, Collection: Parcours, Edition: ONISEP, 2015.
8- The Building and Public Works Trades, Collection: Parcours, Edition: ONISEP, 2016.
9- Transport and logistics professions, Collection: Parcours, Edition: ONISEP, 2016.
10- Energy professions, Collection: Parcours, Edition: ONISEP, 2016.
11- Les métiers de la mécanique, Collection: Parcours, Edition: ONISEP, 2014.
12- Les métiers de la chimie, Collection: Parcours, Edition: ONISEP, 2017.
13- Les métiers du Web, Collection: Parcours, Edition: ONISEP, 2015.
14- The Professions of Biology, Collection: Parcours, Edition: ONISEP, 2016.

Semester: 1
Teaching unit: UET 3.1

Subject: Ethical and deontological dimension (the foundations)
VHS: 10:30 p.m. (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge:

No

Material content:

I. Basics– مفاهم أساسية (2 weeks)

Definitions:

1. Moral:
2. Ethics:
3. "Theory of Duty" Ethics:
4. The law:

5. Distinction between the different concepts
   - A. Distinction between ethics and morality
   - B. Distinction between ethics and professional conduct

II. The Frameworks – 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
Regulations
University Franchise Royalties
University campus stakeholders

IV. University Values – القيم الجامعية (2 weeks)

Social values
Community Values
Professional Values

V. Rights and Duties (2 weeks)

Student Rights
Student Duties
Teachers' rights
Duties of the research professor
Obligations of administrative and technical staff

VI. University Relations (2 weeks)

Definition of the concept of university relations
Student-Teacher Relations
Student-student relationship
Student-Staff Relations
Student-Association Member Relationship

VII. Practices (2 weeks)

Good practices For the teacher
Good practices For the student

References

1. Collection of ethics and deontology courses of Algerian universities.
2. BARBERI (J.-F.), 'Morale et droit des sociétés', *Les Petites Affiches*, n° 68, 7 June 1995.
3. J. Russ, *La pensée éthique contemporaine*, Paris, puf, *Que sais-je?*, 1995.
4. Legault, G. A., Professionalism and Ethical Deliberation, Quebec, Presses de l'Université du Québec, 2003.
5. SIROUX, D., 'Déontologie', in M. Canto-Sperber (ed.), Dictionnaire d'éthique et de philosophie morale, Paris, Quadrige, 2004.
6. Prairat, E. (2009). The teaching professions in the age of ethics. *Education and Societies, 23*.
7. https://elearning.univ-annaba.dz/pluginfile.php/39773/mod_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ontologie.pdf .

Semester: 1
Teaching unit: UET 1.1
Subject 1: French Language1
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

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

Recommended prior knowledge:
Basic French.

Material content:
Below we propose a set of themes that deal with basic sciences, technologies, economics, social facts, communication, sport, health, etc. The teacher can choose from this list of texts to develop 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 to develop his or her language 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 that can be developed as examples. Of course, it is not a question of developing them all or in the same way. Some can be recalled and others well detailed.

Examples of themes	Grammatical structures
Climate change Pollution The electric car Robots Artificial intelligence The Nobel Prize The Olympic Games Sport at school The Sahara The currency Assembly line work Ecology Nanotechnology Optical fibre The engineering profession The power plant Energy efficiency The smart building Wind energy Solar energy	Punctuation. Proper Names, Articles. Grammatical functions: The noun, The verb, The pronouns, The adjective, The adverb. The complementary pronoun ''le, la, les, lui, leur, y, en, me, te, ... ’’ Agreements. The negative sentence. Not... not, Don't ... not yet, Don't ... no more, Don't ... never, Ne ... point... The interrogative sentence. Question with ''Who, What'', Question with ''When, Where, How Much, Why, How, Which, Which''. The exclamatory sentence. Pronominal verbs. Impersonal verbs. Indicative tenses, Present, Future, past compound, simple past, Imperfect. ...

Evaluation method:
Review: 100%.

Bibliographical references:

1. M. Badefort, Objective: Test de Français International, Edulang, 2006.
2. O. Bertrand, I. Schaffner, Réussir le TCF, Exercices et activités d'entrainement, Les éditions de l'école polytechnique, 2009.
3. M. Boulares, J.-L. Frerot, Progressive French Grammar with 400 Exercises, Advanced Level, CLE International.
4. Collective, Besherelles: la Grammaire pour tous, Hatier.
5. Collective, Besherelles: la Conjugaison pour tous, Hatier.
6. M. Grégoire, Grammaire progressive du Français avec 400 exercices, Niveau débutant, CLE International, 1997.
7. A. Hasni et al., La formation à l'enseignement des sciences et des technologies au secondaire (Secondary School Science and Technology Teacher Training), Presses de l'université du Québec, 2006.
8. J.-L. Lebrun, Guide pratique de la rédaction scientifique, EDP Sciences, 2007.
9. J.M. Robert, Difficulties of the Frenchman, Hachette,
10. C. Tisset, Teaching the French Language at School: Grammar, Spelling and Conjugation, Hachette Education, 2005.
11. J. Bossé-Andrieu, Abrégé des Rules de Grammaire et d'Orthographe, Presses de l'université du Québec, 2001.
12. J.-P. Colin, Le français tout ssimples, Eyrolles, 2010.
13. Collectif, Test d'évaluation de Français, Hachette, 2001.
14. Y. Delatour et al., Grammaire pratique du Français en 80 fiches avec exercices correctees, Hachette, 2000.
15. Ch. Descotes et al., L'Exercisier: l'expression française pour le niveau intermediate, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, On the Spot, Heinle Cengage Learning, 2011.
17. J. Dubois et al., Les indispensables – Orthographe, Larousse, 2009.

Semester: 1

Teaching unit: UET 1.1
Subject 1: English Language1
VHS: 10:30 pm (Lecture: 1h30)
Credit: 1
Coefficient: 1

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

Recommended prior Knowledge:
Basic English.

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

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

Rating mode:
Exam: 100%.

References:

1. J. Upjohn, S. Blattes, V. Jans, Minimum Competence in Scientific English, Office des Publications Universitaires, 1994.
2. A.J. Herbert, The Structure of Technical English, Longman, 1972.
3. S. Berland-Delepine, Grammaire méthodique de l'anglais moderne avec exercices, Ophrys, 1982.
4. Test of English as a Foreign Language – Preparation Guide, Cliffs, 1991.
5. R. Fowler, The Little, Brown Handbook, Little, Brown Company, 1980.

6. Cambridge – First Certificate in English, Cambridge books, 2008.
7. K. Wilson, Th. Healy, First Choice, Oxford, 2007.
8. M. Mann, S. Tayore-Knowles, Destination: Grammar & Vocabulary with Answer Key, MacMillan, 2006.
9. E. Hamby, Ph. Bedford Robinson, Special English Computer Applications, Cassell, 1980.
10. P. Charles Brown, Norma D. Mullen, English for Computer Science, Oxford University Press, 1989.
11. Graeme Kennedy, Structure and Meaning in English: A Guide for Teachers, Pearson, 2004.
12. Anne M. Hanson, Brain-Friendly Strategies for Developing Student Writing Skills, 2nd Edition, Corwin Press, 2008.
13. Ann Bridges, How to Pass Higher English, Hodder Gibson-Hachette, 2009.
14. Claude Renucci, 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: UEF 1.2
Subject 1: Mathematics 2
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

Students are led, step by step, to the understanding of mathematics useful to their university curriculum. At the end of the course, the student should be able to: solve differential equations of the first and second degree; 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, ...).

Material content:

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

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

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

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

Chapter 5: Multivariate Functions (2 weeks)
5-1 Limit, continuity, and partial derivatives of a function. 5-2 Differentiability. 5-3 Complete double, triple.

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1- F. Ayres Jr., Theory and Applications of Differential and Integral Calculus - 1175 corrected exercises, McGraw-Hill.
2- F. Ayres Jr., Theory and Applications of Differential Equations - 560 corrected exercises, McGraw-Hill.
3- J. Lelong-Ferrand, J.M. Arnaudiès, Cours de Mathématiques - Equations différentielles, Intégrales multiples, Tome 4, Dunod Université.
4- M. Krasnov, Collection of Problems on Ordinary Differential Equations, Moscow Edition
5- N. Piskunov, Calculus Differential and Integral, Volume 1, Moscow Edition
6- J. Quinet, Cours élémentaire de mathématiques supérieures 3- Calcul intégral et séries, Dunod.

7- J. Quinet, Cours élémentaire de mathématiques supérieures 4- Equations différentielles, Dunod.
8- J. Quinet, Cours élémentaire de mathématiques supérieures 2- Fonctions usuelles, Dunod.
9- J. Quinet, Cours élémentaire de mathématiques supérieures 1- Algèbre, Dunod.
10- J. Rivaud, Algebra: Preparatory Classes and University Volume 1, Exercises with Solutions, Vuibert.
11- N. Faddeev, I. Sominski, Collection of Exercises in Higher Algebra, Moscow Edition.

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

Teaching objectives

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

Recommended Prior Knowledge

Mathematics 1, Physics 1.

Material content:

Math reminders: (1 week)

1- Elements of length, surface, volume in Cartesian, cylindrical, spherical coordinate systems. Solid angle, Operators (gradient, rotational, Nabla, Laplacian and divergence).
2- Multiple derivatives and integrals.

Chapter I. Electrostatics: (6 weeks)

1- Electrostatic charges and fields. Electrostatic interaction force-Coulomb's law.
2-Electrostatic potential. 3- Electric dipole. 4- Flow of the electric field. 5- Gauss's theorem. 6- Balanced conductors. 7- Electrostatic pressure. 8- Capacitance of a conductor and capacitor.

Chapter II. Electrokinetics: (4 weeks)

1- Electrical conductor. 2- Ohm's law. 3- Joule's Law. 4- The Electrical Circuits. 5- Application of Ohm's Law to networks. 6- Kirchhoff's laws. Thevenin's theorem.

Chapter III. Electromagnetism: (4 weeks)

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

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

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

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

Teaching objectives

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

Recommended Prior Knowledge

Basic notions of mathematics and general chemistry.

Material content:

Chapter 1: General information on thermodynamics (3 weeks)

1-Fundamental properties of state functions. 2- Definitions of thermodynamic systems and the external environment. 3- Description of a thermodynamic system. 4- Evolution and thermodynamic equilibrium states of a system. 5- Possible transfers between the system and the external environment. 6- Transformations of the state of a system (operation, evolution). 7- Reminders of the laws of ideal gases.

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

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

Chapter 3 : Applications of the First Law of Thermodynamics to Thermochemistry (3 weeks)

Heat of reaction, the standard state, the standard enthalpy of formation, the enthalpy of dissociation, the enthalpy 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 variation of entropy: reversible isothermal transformation, reversible isochoric transformation, reversible isobaric transformation, adiabatic transformation, during a change of state, during a chemical reaction.

Chapter 5 : The 3rd Principle and Absolute Entropy (1 week)

Chapter 6 : Free energy and enthalpy – Criteria for the evolution of a system (2 weeks)

1- Introduction. 2- Energy and free enthalpy. 3- Chemical balances

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. C. Coulon, S. Le Boiteux S. et P. Segonds, Thermodynamique Physique - Cours et exercices avec solutions, Edition Dunod.
2. H.B. Callen, Thermodynamics, Course, John Wiley and Sons Edition, 1960
3. R. Clerac, C. Coulon, P. Goyer, S. Le Boiteux & C. Rivenc, Thermodynamics, Cours et travaux tutorials de thermodynamique, Université Bordeaux 1, 2003

4. O. Perrot, Cours de Thermodynamique I.U.T. de Saint-Omer Dunkerque, 2011
5. C. L. Huillier, J. Rous, Introduction à la thermodynamique, Edition Dunod.

Semester: 2
Teaching unit: UEM 1.2
Subject 1: Physics 2- Lab Course
VHS: 45h00 (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

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

Evaluation method:

Continuous Assessment: 100%

Semester: 2
Teaching unit: UEM 1.2
Subject 2: Chemistry 2- Lab Course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended Prior Knowledge

Thermodynamics.

Material content:

1. Laws of ideal gases.
2. Water value of the calorimeter.
3. Heat mass: heat density of liquid and solid bodies.
4. Latent heat: Latent melting heat of ice
5. Reaction heat: Determination of the energy released by a chemical reaction (HCl/NaOH)
6. Hess's Law
7. Vapour pressure of a solution.

Evaluation method:

Continuous Assessment: 100%

Semester: 2
Teaching unit: UEM 1.2
Subject 3: Computer Science 2
VHS: 45h00 (Lecture: 1h30, Lab Session: 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: Index Variables (4 weeks)
1- One-dimensional arrays: Representation in memory, Operations on arrays
2- Two-dimensional arrays: Representation in memory, Operations on two-dimensional arrays

Chapter 2: Functions and Procedures (6 Weeks)
1- Functions: Types of functions, declaration of functions, call of functions
2- Procedures: Notions of global variables and local variables, simple procedure, procedure with arguments

Chapter 3: Recordings and Files (5 Weeks)
1- Heterogeneous data structure
2- Structure of a record (notion of fields)
3- Manipulation of record structures
4- Notion of file
5- File access methods
6- Reading and writing to a file

Computer Science 2 :

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

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

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: Basics Book by Thomas H. Cormen 2013.

Semester: 2
Teaching unit: UEM 1.2
Subject 4: Presentation methodology
VHS: 15:00 (Lecture: 1:00 am)
Credits: 1
Coefficient: 1

Teaching objectives

To give the main basics for a successful oral presentation. Skills to be acquired include: Preparing a presentation; Know how to present a presentation; Knowing how to capture the attention of the audience; Be aware of the pitfalls of plagiarism and know the regulations of intellectual property.

Recommended Prior Knowledge

Techniques of expression and communication and Methodology of writing.

Material content:

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

Chapter 2: 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 works 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: Submitting a written work (6 weeks)
- Submit a written assignment. Applications: Oral presentation.

Evaluation method:

Review: 100%.

References:

1. M. Fayet, Methods of Written and Oral Communication, 3rd edition, Dunod, 2008.
2. M. Kalika, Master's thesis – Piloting a dissertation, Writing a report, Preparing a defense, Dunod, 2016.
3. M. Greuter, Réussir son mémoire et son rapport de placement, L'Etudiant, 2014
4. B. Grange, Réussir une presentation. Prepare impactful slides and communicate well in public. Eyrolles, 2009.
5. H. Biju-Duval, C. Delhay, Tous orateurs, Eyrolles, 2011.
6. C. Eberhardt, Practical work with PowerPoint. Creating and Laying Out Slides, Dunod, 2014.
7. F. Cartier, Written and oral communication, Edition GEP- Groupe Eyrolles, 2012.
8. L. Levasseur, 50 exercises for public speaking, Eyrolles, 2009.
9. S. Goodlad, Speaking technically – A Handbook for Scientists, Engineers, and Physicians on How to Improve Technical Presentations, Imperial College Press, 2000.
10. M. Markel, Technical communication, eleventh edition, Bedford/St Martin's, 2015.

Semester: 2
Teaching unit: UED 1.2
Subject 1: Careers in Science and Technology 2
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Purpose of the material:
In the first stage, the student will be introduced to all the courses that are covered by the Science and Technology Field, and in the second stage, a wide range of professions to which these courses lead. 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 it.

Recommended Prior Knowledge
No.

Content of the material:
1. Industrial Health and Safety (HSI) and Mining Engineering courses : **(2 weeks)**
- Definitions and fields of application (Safety of goods and people, Environmental problems, Exploration and exploitation of mining resources, etc.)
- Role of the specialist in these areas.

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

3. Courses in Civil Engineering, Hydraulics and Public Works: (2 weeks)
- Definitions and fields of application (Construction materials, Large road and rail infrastructures, Bridges, Airports, Dams, Drinking water supply and sanitation, Water flows, Water resources management, Public works and Spatial planning, Smart cities, etc.)
- Role of the specialist in these areas.

4. Aeronautics, Mechanical Engineering, Marine Engineering and Metallurgy Sector: (2 weeks)
- Definitions and fields of application (Aeronautics, Avionics, Automotive industry, Ports, Breakwaters, Industrial equipment production, Steel industry, Metal processing, etc.)
- Role of the specialist in these areas.

5. Approaches for sustainable production: (2 weeks)
Industrial ecology, Remanufacturing, Eco-design.

6. Measuring the sustainability of a process/product/service: (2 weeks)
Environmental analysis, Life cycle assessment (LCA), Carbon footprint, case studies/applications.

7. Sustainability and Business: (3 weeks)
Definition of the company as an economic entity (notions of profit, costs, performance) and social entity (notion of social responsibility of the company), Impact of economic activities on the environment (examples), Issues/benefits of SD for the company, Means of engagement in an SD approach (e.g. ISO 14001 certification, labelling (e.g. energy label, Ecolabel, Organic/AB label, FSC label, etc.), SD strategic plan, Global Reporting Initiative (GRI)...), Global rankings of the most sustainable companies (Dow Jones Sustainable Index, Global 100, ...), Case studies of high-performing/eco-responsible companies in ST sectors (e.g. SIEMENS, Cisco, Henkel AG & Co, TOTAL, Peugeot, Eni SPA ...).

The student's personal work for this subject:

- **Working in groups/pairs :** Reading articles on sustainable development and/or reports of successful and sustainable companies and elaborating summaries of the main actions undertaken in the field of SD. Examples of documents for reading and summarizing:
  - Case of ONA and ENIEM: Kadri, Mouloud, 2009, Sustainable Development, Business and ISO 14001 Certification, Market and Organizations Vol. 1 (No. 8), p. 201-215 (Open Online: http://www.cairn.info/revue-marche-et-organisations-2009-1-page-201.htm)
  - Mireille Chiroleu-Assouline. Corporate sustainability strategies. Idées, La revue des sciences économiques et sociales, CNDP, 2006, p 32-39 (free access online: http://halshs.archives-ouvertes.fr/hal-00306217/document)
  - TOTAL's Environmental and Societal Commitments webpage : https://www.total.com/fr/engagement
  - Sustainable mobility innovations from Groupe PSA: http://www.rapportannuel.groupe-psa.com/rapport-2015/engagements/dessolutions-innovantes-pour-des-transports-durables/

Evaluation method:

100% Review

References:

1- V. Maymo and G. Murat, The Sustainable Development and CSR Toolbox - 53 Tools and Methods, Edition: Dunod, 2017.
2- P. Jacquemot and V. Bedin, The Encyclopedic Dictionary of Sustainable Development, Edition: Sciences Humaines, 2017.
3- Y. Veyret, J. Jalta and M. Hagnerelle, Sustainable Developments: All the Challenges in 12 Lessons, Edition: Autrement, 2010.
4- L. Grisel and Ph. Osset, The Life Cycle Assessment of a Product or Service: Applications and Practice, 2nd Edition: AFNOR, 2008.
5- Sh. Shaked, N. Jolliet-Gavin, P. Crettaz, M. Saadé-Sbeih and O. Jolliet, Life Cycle Assessment: Understanding and Carrying Out an Eco-Assessment, 3rd Edition: PPUR, 2017.
6- G. Pitron and H. Védrine, The War of Rare Metals: The Hidden Face of the Energy and Digital Transition, Edition: Liens qui libient, 2018.
7- Les métiers de l'environnement et du développement durable, Collection: Parcours, Edition: ONISEP, 2015.

Semester: 2
Teaching unit: UET 1.2
Subject 1: French Language 2
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

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

Recommended prior knowledge:
Basic French.

Material content:
Below we propose a set of themes that deal with basic sciences, technologies, economics, social facts, communication, sport, health, etc. The teacher can choose from this list of texts to develop 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 to develop his or her language 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 that can be developed as examples. Of course, it is not a question of developing them all or in the same way. Some can be recalled and others well detailed.

Examples of themes	Grammatical structures
The pharmaceutical industry The food industry The national employment agency ANEM Sustainable development Renewable energies Biotechnology Stem cells Road safety The dams Water – Water Resources Avionics Automotive electronics Electronic newspapers Carbon-14 dating Violence in stadiums Drugs: a social scourge Smoking Failure at school The Algerian War Social networks China, an economic power Superconductivity Cryptocurrency	The subjunctive. The conditional. The imperative. The past participle. The passive form. Possessive adjectives, Possessive pronouns. The demonstratives, The demonstrative pronouns. The expression of quantity (several, some, enough, much, more, less, as much, ...). Numbers and measures. The pronouns ''who, that, where, don''t'. Subordinate preposition of time. The cause, the consequence. The goal, the opposition, the condition. Comparisons, superlatives. ...

Advertising Autism	

Evaluation method:

Review: 100%.

Bibliographical references:

1. M. Badefort, Objective: Test de Français International, Edulang, 2006.
2. O. Bertrand, I. Schaffner, Réussir le TCF, Exercices et activités d'entrainement, Les éditions de l'école polytechnique, 2009.
3. M. Boulares, J.-L. Frerot, Progressive French Grammar with 400 Exercises, Advanced Level, CLE International.
4. Collective, Besherelles: la Grammaire pour tous, Hatier.
5. Collective, Besherelles: la Conjugaison pour tous, Hatier.
6. M. Grégoire, Grammaire progressive du Français avec 400 exercices, Niveau débutant, CLE International, 1997.
7. A. Hasni et al., La formation à l'enseignement des sciences et des technologies au secondaire (Secondary School Science and Technology Teacher Training), Presses de l'université du Québec, 2006.
8. J.-L. Lebrun, Guide pratique de la rédaction scientifique, EDP Sciences, 2007.
9. J.M. Robert, Difficulties of the Frenchman, Hachette,
10. C. Tisset, Teaching the French Language at School: Grammar, Spelling and Conjugation, Hachette Education, 2005.
11. J. Bossé-Andrieu, Abrégé des Rules de Grammaire et d'Orthographe, Presses de l'université du Québec, 2001.
12. J.-P. Colin, Le français tout ssimples, Eyrolles, 2010.
13. Collectif, Test d'évaluation de Français, Hachette, 2001.
14. Y. Delatour et al., Grammaire pratique du Français en 80 fiches avec exercices correctees, Hachette, 2000.
15. Ch. Descotes et al., L'Exercisier: l'expression française pour le niveau intermediate, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, On the Spot, Heinle Cengage Learning, 2011.
17. J. Dubois et al., Les indispensables – Orthographe, Larousse, 2009.

Semester: 2
Teaching unit: UET 1.2
Subject 1: English Language 2
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

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

Recommended prior Knowledge:
Basic English.

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

Examples for some lectures:	**Examples of Word Study: Patterns**
Radioactivity. Chain Reaction. Reactor Cooling System. Conductor and Conductivity. Induction Motors. Electrolysis. Liquid Flow and Metering. Liquid Pumps. Petroleum. Road Foundations. Rigid Pavements. Piles for Foundations. Bridges suspension.	Explanation of Cause Result 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

Rating mode:
Exam: 100%.

References:

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

9. E. Hamby, Ph. Bedford Robinson, Special English Computer Applications, Cassell, 1980.
10. P. Charles Brown, Norma D. Mullen, English for Computer Science, Oxford University Press, 1989.
11. Graeme Kennedy, Structure and Meaning in English: A Guide for Teachers, Pearson, 2004.
12. Anne M. Hanson, Brain-Friendly Strategies for Developing Student Writing Skills, 2nd Edition, Corwin Press, 2008.
13. Ann Bridges, How to Pass Higher English, Hodder Gibson-Hachette, 2009.
Claude Renucci, 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 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

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

Recommended Prior Knowledge

Mathematics 1 and Mathematics 2

Content of the material:

Chapter 1: Single and Multiple Integrals **3 weeks**

1.1 Reminders on the Riemann integral and on the calculus 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 extremities.

Chapter 3: Differential Equations **2 weeks**

3.1 Reminder of the ordinary differential equations. 3.2 Partial differential equations. 3.3 Special Functions.

Chapter 4: Sets **3 weeks**

4.1 Numerical series. 4.2 Sequences and series of functions. 4.3 Whole series, Fourrier series.

Chapter 5: Fourier Transform **3 weeks**

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

Chapter 6: Laplace's transformation **2 weeks**

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

Method of evaluation:

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

References:

1- F. Ayres Jr., Theory and Applications of Differential and Integral Calculus - 1175 corrected exercises, McGraw-Hill.
2- F. Ayres Jr., Theory and Applications of Differential Equations - 560 corrected exercises, McGraw-Hill.
3- J. Lelong-Ferrand, J.M. Arnaudiès, Cours de Mathématiques - Equations différentielles, Intégrales multiples, Tome 4, Dunod Université.
4- M. Krasnov, Collection of Problems on Ordinary Differential Equations, Moscow Edition
5- N. Piskunov, Calculus Differential and Integral, Volume 1, Moscow Edition
6- J. Quinet, Cours élémentaire de mathématiques supérieures 3- Calcul intégral et séries, Dunod.
7- J. Quinet, Cours élémentaire de mathématiques supérieures 4- Equations différentielles, Dunod.

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

Semester: 3
Teaching unit: UEF 2.1.1
Subject 2: Waves and Vibrations
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

To introduce the student to the phenomena of mechanical vibrations restricted to small 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 material:

***Preamble**: This subject is divided into two parts, the Waves part and the Vibrations part, which can be approached independently of each other. In this regard, and because of 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 courses (Group A). While for students in Groups B and C (Civil Engineering, Mechanical Engineering and Process Engineering), it is wise to start with Vibrations. In any case, the teacher is called upon to do his or her best to cover both parts. We remind you that this subject is intended for engineering professions in the Science and Technology Field. Also, the teacher is asked to go over all the parts of the course that require demonstrations or theoretical developments and to focus only on the application aspects. Moreover, the demonstrations can be the subject of auxiliary work to be asked of the students as activities within the framework of the student's personal work. On this subject, please refer to the paragraph "G- Evaluation of the student through continuous assessment and personal work" 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 The case of conservative systems
1.1.3 Velocity-dependent frictional forces
1.1.4 Case of an external time-dependent force
1.2 Multi-degree-of-freedom system.

Chapter 2: Free Oscillations of Systems at a Degree of Freedom 2 weeks

2.1 Undamped Oscillations
2.2 Free Oscillations of Damped-Systems

Chapter 3: Forced Oscillations of Systems at a Degree of Freedom 1 week

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

Chapter 4: Free Oscillations of Two-Degree-of-Freedom Systems **1 week**

4.1 Introduction
4.2 Two-degree-of-freedom systems

Chapter 5: Forced Oscillations of Two-Degrees-of-Freedom Systems **2 weeks**
5.1 Lagrange equations
5.2 Mass-spring-shock absorber system
5.3 Impedance
5.4 Applications
5.5 Generalization to n-degree-of-freedom systems

Part B: Waves
Chapter 1: Phenomena of one-dimensional propagation **2 weeks**
1.1 General and basic definitions
1.2 Propagation equation
1.3 Solution of the propagation equation
1.4 Sine Wave Traveling
1.5 Superposition of Two Sinusoidal Traveling Waves

Chapter 2: Vibrating Strings **2 weeks**
2.1 Wave equation
2.2 Harmonic Traveling Waves
2.3 Free Oscillations of a Finite Length String
2.4 Reflection and transmission

Chapter 3: Acoustic waves in fluids **1 week**
3.1 Wave equation
3.2 Speed of sound
3.3 Sine Wave Travelings
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

Method of evaluation:
Continuous assessment: 40%; Final exam: 60%.

Bibliographical 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; Hermès 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 des Publications Universitaires, 2011.

Semester: 3
Teaching unit: UEF 2.1.2
Subject 1: Fundamental Electronics 1
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

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

Recommended Prior Knowledge

Notions of materials physics and fundamental electricity.

Content of the material:

The number of weeks displayed is given as an indication. It is obvious that the course leader is not required to strictly respect this sizing 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, Theorem of maximum power transfer.

Chapter 2. Passive quadrupoles 3 weeks

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

Chapter 3. Diodes 3 weeks

Basic reminders on the physics of semiconductors: Definition of a semiconductor, Crystal Si, Notions of doping, N and P semiconductors, PN junction, Constitution and operation of a diode, forward and reverse polarizations, Current-voltage characteristic, static and variable regime, Equivalent diagram. Applications of diodes: Single and double alternating rectifiance. 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, ...), Static characteristics network, Polarizations, Load line, Rest point, ... Study of the three fundamental assemblies: EC, BC, DC, Equivalent Scheme, Voltage Gain, Decibel Gain, Bandwidth, Current Gain, Input and Output Impedances. Study of LF multistage amplifiers in static and dynamic regimes, link capacitors, decoupling capacitors. Other uses of the transistor: Darlington assembly, switching transistor, ...

Chapter 5 - Operational amplifiers: 3 weeks

Principle, Equivalent Schematic, Ideal Op-Amp, Feedback, Op-Amp Features, Basic Op-Amp Setups: Inverter, Non-Inverter, Summer, Subtractor, Comparator, Follower, Diverter, Integrator, Logarithmic, Exponential, ...

Method of evaluation:

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

References:

1. A. Malvino, Principe d'Electronique, 6th Edition Dunod, 2002.
2. T. Floyd, Electronics Components and Application Systems, 5th Edition, Dunod, 2000.
3. F. Milsant, Cours d'électronique (et problèmes), Tomes 1 à 5, Eyrolles.
4. M. Kaufman, Electronics: The Components, Volume 1, McGraw-Hill, 1982.
5. P. Horowitz, Traité de l'électronique Analogue et Numérique, Tomes 1 et 2, Publitronic-Elektor, 1996.
6. M. Ouhrouche, Circuits électriques, Presses internationale Polytechnique, 2009.
7. Neffati, Electricité générale, Dunod, 2004
8. D. Dixneuf, Principes des circuits électriques, Dunod, 2007
9. Y. Hamada, Electronic Circuits, OPU, 1993.
10. I. Jelinski, Toute l'électronique en exercices, Vuibert, 2000.

Semester: 3
Teaching unit: UEF 2.1.2
Subject 2:Basic electrical engineering 1
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives :

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

Recommended prior knowledge:

Notions of fundamental electricity.

Content of the material:

Chapter 1. Mathematical reminders on complex numbers (NC) (1 Week)
Cartesian form, conjugated NCs, Modulus, Arithmetic operations on CNs (addition, ...), Geometric representation, Trigonometric form, Moivre's formula, root of CNs, Exponential representation of an NC, Trigonometric application of Euler's formulas, Application of CNs to electricity.

Chapter 2. Reminders on the Fundamental Laws of Electricity (2 Weeks)
Continuous regime: electric dipole, combination of R, C, L dipoles.
Harmonic regime: representation of sinusoidal quantities, mean and effective values, Fresnel representation, complex notation, impedances, powers in sinusoidal regime (instantaneous, active, apparent, reactive), Boucherot's theorem.
Transient: RL circuit, RC circuit, RLC circuit, capacitor charge and discharge.

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. Own and mutual inductors. Magnetic electrical analogy.

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

Chapter 6. Introduction to Electrical Machines (3 weeks)
General information on electrical machines. Working principle of generator and motor. Power balance and efficiency.

Method of evaluation :

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

Bibliographical references :

(Subject to the availability of documentation at the facility level, Websites... etc.)

1. J.P. Perez, Electromagnetism Foundations and Applications, 3rd Edition, 1997.
2. A. Fouillé, Electrotechnique à l'Usage des Ingénieurs, 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, Circuits et mesures électriques, Dunod, 2009
7. M. Kostenko, Electrical Machines - Volume 1, Volume 2, MIR Editions, Moscow, 1979.
8. M. Jufer, Electromécanique, Presses polytechniques et universitaires romandes- Lausanne, 2004.
9. A. Fitzgerald, Electric Machinery, McGraw-Hill Higher Education, 2003.
10. J. Lesenne, Introduction à l'électrotechnique approfondie. Technique et Documentation, 1981.
11. P. Maye, Industrial Electric Motors, Dunod, 2005.
12. S. Nassar, Electrical Circuits, Maxi Schaum.

Semester: 3
Teaching unit: UEM2.1
Subject 1: Probability and statistics
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Objectives of the subject

This module allows students to see the essential notions of probability and statistics, namely: one- and two-variable statistical series, 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: Single-variable statistical series **(3 weeks)**

A.2.1 Staff, frequency, percentage.
A.2.2 Cumulative Staff, Cumulative Frequency.
A.2.3 Graphical representations: bar chart, pie chart, bar chart. Polygon of numbers (and frequencies). Histogram. Cumulative curves.
A.2.4 Position characteristics
A.2.5 Dispersion characteristics: range, variance and standard deviation, coefficient of variation.
A.2.6 Shape characteristics.

Chapter 3: Two-variate statistical series **(3 weeks)**

A.3.1 Data tables (contingency table). Point cloud.
A.3.2 Marginal and conditional distributions. Covariance.
A.3.3 Linear correlation coefficient. Regression line and Mayer line.
A.3.4 Regression curves, regression corridor and correlation ratio.
A.3.5 Functional adjustment.

Part B: Probability

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

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

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

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

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

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

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

Chapter 5: Common Discrete and Continuous Probability Distributions (3 weeks)
Bernoulli, binomial, Poisson, ...; Uniform, normal, exponential, ...

Method of evaluation:
Continuous assessment: 40%; Final exam: 60%.

References:
1. D. Dacunha-Castelle and M. Duflo. Probability and Statistics: Fixed-time problems. Masson, 1982.
2. J.-F. Delmas. Introduction to the calculation of probability 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. Course in mathematical statistics. Economica, 1988.
7. A. Montfort. Introduction to statistics. Ecole Polytechnique, 1991

Semester: 3
Teaching unit: UEM2.1
Subject 2: Computer Science 3
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Objectives of the material:

Teach the student programming using easy-to-access software (essentially: Matlab, Scilab, Mapple, ...). This subject will be a tool for the realization of the practical work of numerical methods in S4.

Recommended prior knowledge:

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

Content of the material:

Lab 1: Presentation of a scientific programming environment (1 week)

(Matlab, Scilab, ... etc.)

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

Lab 3: Reading, Viewing and Saving Data (2 weeks)

Lab 4: Vectors and Matrices (2 weeks)

Lab 5: Control Instructions (For and While Loops, If and Switch Instructions) (2 Weeks)

Lab 6: Function Files (2 weeks)

Lab 7: Graphic design (Management of graphics windows, plot) (2 weeks)

Lab 8: Using toolbox (2 weeks)

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references :

1. Jean-Pierre Grenier, Débuter en algorithmique avec MATLAB et SCILAB, Ellipses, 2007.
2. Laurent Berger, Scilab from theory to practice, 2014.
3. Bégyn Arnaud, Gras Hervé, Grenier Jean-Pierre, Programming and simulation in Scilab, 2014.
4. Thierry Audibert, Amar Oussalah, Maurice Nivat, Computer Science: Programming and Scientific Computing in Python and Scilab 1st and 2nd year scientific preparatory classes, Ellipses, 2010.

Semester: 3
Teaching unit: UEM 2.1
Subject 3: Practical work in Electronics and Electrical Engineering- Lab Course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

Consolidation of the knowledge acquired in the fundamental subjects of electronics and electrical engineering 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 practical work teacher is called upon to complete at least 3 practical exercises in Electronics and 3 practical exercises in Electrical Engineering from the list of practical exercises proposed below:

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

Electrical Engineering Practical Work 1
Lab 1: Measurement of voltages and currents in single-phase
Lab 2: Measuring voltages and currents in three-phase
Lab 3: Measurement of active and reactive power in three-phase
Lab 4: Magnetic circuits (hysteresis cycle)
Lab 5: Transformer Testing
Lab 6: Electrical machines (demonstration).

Method of evaluation:

Continuous assessment: 100%

References:

Semester: 3
Teaching unit: UEM 2.1
Subject 4: Waves and Vibrations – Lab Course
VHS: 15:00 (Lab session: 1h00)
Credits: 1
Coefficient: 1

Teaching objectives

The objectives assigned by this program are to introduce students to put into practice the knowledge received on the phenomena of mechanical vibrations restricted to small 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 material:

Lab1 : Mass – spring
Lab2 : Simple clock
Lab3 : Torsion pendulum
Lab4 : Oscillating electrical circuit in free and forced regime
Lab5 : Coupled Pendulums
Lab6: Transverse Oscillations in Vibrating Wires
Lab7 : Groove pulley according to Hoffmann
Lab8: Electromechanical Systems (The Electrodynamic Loudspeaker)
Lab9: Pohl's pendulum
Lab10: Propagation of longitudinal waves in a fluid.

Note: It is recommended to choose at least 5 practical exercises among the 10 proposed.

Method of evaluation:

Continuous assessment: 100%.

Bibliographical references:

Semester: 3
Teaching Unit: UED 2.1
Subject 1: State of the art of electrical engineering
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

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

Recommended Prior Knowledge
No

Content of the material:

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

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

Assessment method: Final exam: 100%.

Bibliographical references:
(Subject to the availability of documentation at the facility level, Websites... etc.)

Semester: 3
Teaching Unit: UED 2.1
Subject 2: Energy and environment
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge:

Notions of energy and environment.

Content of the material:

Chapter 1: The Different Energy Resources

Chapter 2: Energy Storage

Chapter 3: Consumption, reserves and trends in energy resources

Chapter 4: The different types of pollution

Chapter 5: Detection and treatment of pollutants and wastes

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

Method of evaluation:

Final exam: 100%.

Bibliographical 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, Energie solaire photovoltaïque, 4th ed., Dunod, 2009-10.

Semester: 3
Teaching unit: UET 2.1
Subject 1: Technical English
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This course should allow the student to acquire a sufficiently significant level of language to allow him to use a scientific document and speak of his specialty and his field of study 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, vocabulary acquisition, grammar, ... etc.
- Nouns and adjectives, comparatives, following and giving instructions, identifying things.
- Use of numbers, symbols, equations.
- Measurements: Length, area, volume, power, ... etc.
- Describe scientific experiments.
- Characteristics of scientific texts.

Method of evaluation:

Final exam: 100%.

Bibliographical references :

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

Semester: 4
Teaching unit: UEF 2.2.1
Subject 1: Linear and continuous servo systems
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

This course will allow the student to acquire knowledge on the control theory of continuous linear systems as well as on representation and analysis methods. By the end of the course, students will be able to model, analyze, and design simple controllers for automated systems.

Recommended Prior Knowledge

- Basic mathematics (Algebra, analysis, especially the manipulation of complex values, etc.)
- Basic notions of basic electronics (linear circuits) and physics.

Content of the material:

Chapter 1: General information on servo systems (2 weeks)

Overview of the history of control systems, Terminology of servo systems (disturbance, setpoint, control, output, measurement noise, deviation, tracking, regulation, corrector, etc.), Automatic functions (monitoring/safety, control/regulation), Open-loop/closed-loop control, Structure and components of a control system.

Chapter 2: Laplace Transforms and Representation of Servo Systems (3 weeks)

Laplace transform of usual functions (definitions, properties, initial and final value theorem, ...), Inverse Laplace transform (definitions, properties, ...), Mathematical model of a system, Representation by differential equations, Representation of systems servoed by transfer functions (definition of static gain, poles, zeros of a transfer function), Block diagrams and simplification rules: series systems, parallel, unitary and non-unitary return, ...

Chapter 3: Time-domain analysis (2 weeks)

Transient regime, steady state and notions of stability, speed and static precision, Notion of impulse response, Response of first and second order systems for typical signals, Case of higher order systems, Identification of first and second order systems from the temporal response.

Chapter 4: Frequency domain systems analysis (4 weeks)

Introduction, Graphical representation of transfer functions (Bode diagrams, Nyquist place, Black-Nichols charts), Analysis and stability criteria (Bode/Nyquist plane reverse criterion, Nyquist criterion, Evans place, Routh criterion)

Chapter 5: Systems Synthesis (4 weeks)

Introduction, Synthesis specifications (stability, speed, accuracy), Different regulator structures (phase advance/delay, PID, RST), Choice of regulator according to the imposed specifications, Sizing of regulators:Synthesis by empirical methods (Ziegler-Nichols, Flat, symmetrical, ...), Synthesis by graphical methods (Evans, Bode, Black, Nyquist, ...).

Method of evaluation:
Continuous assessment: 40%; Final exam: 60%.

References:
1- Y. Granjon, Automatique - systèmes linéaires et continuous, Dunod 2003.
2- S. Le Ballois and P. Cordon, Automatique - systèmes linéaires et continus, Dunod 2006.
3- K. Ogata, Modern Control Engineering, Prentice Hall, 2010.
4- B. Kuo et al., Automatic Control Systems, John Wiley and Sons, 2008.

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

Teaching objectives:

Know the usual combinatorial circuits. To know how to design some applications of combinatorial circuits using standard tools such as truth tables and Karnaugh tables. Introduce sequential circuits through toggle circuits, counters and registers.

Recommended Prior Knowledge

None.

Content of the material:

The number of weeks displayed is given as an indication. It is obvious that the course leader is not required to strictly respect this sizing or the arrangement of the chapters.

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

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

Chapter 2: Numeral Systems and Information Coding 2 weeks

Representation of a number by codes (binary, hexadecimal, DCB, signed and unsigned binary, ...) base change or conversion, unweighted codes (Gray's code, error detector and corrector codes, ascii code, ...), arithmetic operations in binary code.

Chapter 3: Transcoder Combinatorial Circuits 2 weeks

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

Chapter 4: Combinatorial Switchgear Circuits 2 weeks

Definitions, Multiplexers, Demultiplexers, Cascading, Applications, Switch IC Datasheet Analysis, IC List.

Chapter 5: Combinatorial Comparison Circuits 2 weeks

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

Chapter 6: The Seesaws 2 weeks

Introduction to sequential circuits. The RS scale, The RST scale, The D scale, The Master-slave scale, The T scale, The JK scale. Examples of applications with toggles: Frequency divider by n, Pulse train generator, ...
It is advisable to present for each switch the truth table, examples of chronograms as well as the limits and imperfections.

Chapter 7: Meters 2 weeks

Definition, Classification of counters (synchronous, regular, irregular, asynchronous, full and incomplete cycles). Realization of complete and incomplete synchronous binary counters, Excitation tables of JK, D and RS toggles, Realization 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, offset registers, loading and retrieving data in a register (PIPO, PISO, SIPO, SISO), offsetting data in a register, a universal register, the 74LS194A, available integrated circuits, Applications: classic registers, special counters, queues.

Method of evaluation:

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

References:

1- J. Letocha, Introduction to Logic Circuits, McGraw Hill Edition.
2- J.C. Lafont, Cours et problèmes d'électronique numérique, 124 exercices avec solutions, Ellipses.
3- R. Delsol, Digital Electronics, Volumes 1 and 2, Edition Berti
4- P. Cabanis, Digital Electronics, Dunod Edition.
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- J-P. Ginisti, La logique combinatoire, Paris, PUF (coll. "Que sais-je?" n°3205), 1997.
11- J-L. Krivine, Lambda-calculus, types and models, Masson, 1990, chap. Combinatorial logic, English translation available on the author's website.

Semester: 4
Teaching unit: UEF 2.2.2
Subject 1: Numerical methods
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge:

Mathematics 1, Mathematics 2, Computer Science1 and Computer Science 2.

Content of the material:

Chapter 1. Solving the nonlinear equations f(x)=0 (3 weeks)
1. Introduction to calculation errors and approximations, 2. Introduction to methods for solving nonlinear equations, 3. Method of bisection, 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's 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. Trapeze method, 3. Simpson's Method, 4. Quadrature formulas.

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

Chapter 6. Method for the direct solution of systems of linear equations (2 weeks)
1. Introduction and definitions, 2. Gauss's method and pivoting, 3. LU Factorization Method, 4. Choeleski factorization method MMt, 5. Thomas algorithm (TDMA) for tri-diagonal systems.

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

Method of evaluation:

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

Bibliographical references :

1. C. Brezinski, Introduction à la pratique du calcul numérique, Dunod, Paris 1988.
2. G. Allaire and S.M. Kaber, Numerical Linear Algebra, Ellipses, 2002.
3. G. Allaire and S.M. Kaber, Introduction to Scilab. Exercices pratiques correctes d'algèbre linéaire, Ellipses, 2002.
4. G. Christol, A. Cot and C.-M. Marle, Calculus Differential, Ellipses, 1996.
5. M. Crouzeix and A.-L. Mignot, Analyse numérique des équations différentielles, Masson, 1983.

6. S. Delabrière and M. Postel, Méthodes d'approximation. Differential equations. Applications Scilab, Ellipses, 2004.
7. J.-P. Demailly, Analyse numérique et équations différentielles. Presses Universitaires de Grenoble, 1996.
8. E. Hairer, S. P. Norsett and G. Wanner, Solving Ordinary Differential Equations, Springer, 1993.
9. P. G. 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 (Lecture: 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 material:

Chapter 1. General information about signals (3 weeks)

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

Chapter 2. Fourier analysis (4 weeks)

Introduction, Mathematical reminders (dot product, Euclidean distance, linear combination, orthogonal basis, etc.) 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 translational invariant systems or SLIT (Temporal and Frequency Analysis).

Chapter 4. Convolution Product (2 weeks)

Convolution Product Formulation, Convolution Product Properties, Convolution Product and Dirac Pulse.

Chapter 5. Signal correlation (3 weeks)

Finite total energy signals. Signals with finite total average power. Intercorrelation between signals, Autocorrelation, Properties of the correlation function. Energy spectral density and power spectral density. Wiener–Khintchine theorem. Case of periodic signals.

Method of evaluation:

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

References:

1. S. Haykin, "Signals and systems", John Wiley & Sons, 2nd ed., 2003.
2. A.V. Oppenheim, "Signals and systems", Prentice-Hall, 2004.
3. F. de Coulon, "Théorie et traitement des signalaux", 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. M. Benidir, "Theory and Signal Processing, Volume 1: Representation of Signals and Systems - Corrected Courses and Exercises", Dunod, 2004.
7. M. Benidir, "Theory and Processing of the Signal, Volume 2: Basic Methods for the Analysis and Processing of the Signal - Corrected Courses and Exercises", Dunod, 2004.
8. J. Max, Signal Processing

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

Teaching objectives:

Introduce the student to the techniques of measuring electrical and electronic quantities. Familiarize him 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 is given as an indication. It is obvious that the course leader is not required to strictly respect this sizing 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 accuracy, Measurement error, Classification of errors, Uncertainties in indirect measurements, Qualities of measuring apparatus, Calibration of measuring apparatus, Graphic symbols of measuring apparatus, General methods of measurement (Deviation, zero, resonance methods), Application exercises.

Chapter 2. Measurement methods 6 weeks

1. Voltage measurements: Direct methods of voltage measurements, Alternating voltage measurements, Indirect method of voltage measurements by the opposition method.
2. Current measurement: Direct method of measuring currents, Using simple shunt.
3. Resistance measurements: Classification of resistances, Volt-ampere method, Zero method: Wheatstone Bridge, Measurement of very large resistances by the pressure drop method.
4. Impedance measurements: Capacitance measurements, Inductance measurements, AC bridges.
5. Continuous Power Measurements: Fundamental Relationship, Ammeter and Voltmeter Method, Continuous Electrodynamic Power Meter.
6. Alternating Power Measurements: Instantaneous and Average Power, Complex Power, Apparent Power, Active Power and Reactive Power, Electrodynamic Alternating Power Meter, 3-Voltmeter Method for Active Power, Direct Reactive Power Measurement Method, Indirect Reactive Power Measurement Method
7. Phase shift measurements: Direct measurement of phase shifts with the oscilloscope, Measurement of phase shifts with Lissajous figures.
8. Frequency and period measurements: Direct frequency measurement with an oscilloscope, Frequency measurement with Lissajous figures, Frequency measurement by the frequency meter method, Frequency measurement by the period meter method, Application exercises.

Chapter 3. Measuring devices 4 weeks

Introduction
Analogue measuring devices: Classification of deviation devices, The moving frame galvanometer, Structure of the magnetoelectric ammeter, Structure of the magnetoelectric voltmeter, Operation of the electrodynamic power meter in alternating
Digital measuring devices: Analog-to-digital converters (ADCs), Principle of operation of a digital measuring device, Examples of digital measuring devices (Multimeter, Oscilloscope, etc.).
Practical work Electrical and electronic measurements:

Lab N° 1: Resistance measurement:

Perform the measurement of resistances by the following 5 methods: volt-ampere, ohmmeter, Wheatstone bridge, comparison and substitution.
Compare these methods with each other and calculate errors.

Lab N° 2: Inductance measurement:

Measure inductances using the following 3 methods: volt-amperetry, Maxwell bridge, resonance.
Compare these methods with each other and calculate errors.

Lab N° 3: Capacity measurement:

Measure capacitances using the following 3 methods: volt-amperetry, Sauty bridge, resonance.
Compare these methods with each other and calculate errors.

Lab N° 4: Phase shift measurement:

Perform the resistance measurement by the following 2 methods: Phase meter and oscilloscope.

Lab N° 5: Single-phase power measurement:

Perform the measurement of resistances by the following 5 methods: power meter, Cosφmeter, three voltmeters, three ammeters, power meter.
Compare these methods with each other and calculate errors.

Lab N° 6: Three-phase power measurement:

Measure resistances by the following methods: Star system and triangle system, balanced and unbalanced.

Method of evaluation:

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

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, Measures and PC, ETSF Edition.
4- D. Hong, Circuits et mesures électriques, 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- J. P. Bentley, Principles of Measurement Systems, Pearson Education, 2005.
10- J. Niard, Electrical Measures, Nathan, 1981.
11- P. Beauvilain, Electrical and Electronic Measurements.
12- M. Abati, Applied Electronic Measures, Delagrave Technical and Standardization Collection.
13- P. Jacobs, Electrical Measurements, Edition Dunod.
14- A. Leconte, Measurements in Electrical Engineering (Document D 1 501), Engineering Techniques.

Internet sources :

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

Semester: 4
Teaching unit: UEM 2.2
Subject 2: Linear and Continuous Servo Systems
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

To introduce students to apply the knowledge acquired on the theory of control systems. Teach the student how to use the tools to model, analyze, and design simple controllers for automated systems.

Recommended prior knowledge:

Linear and continuous servo systems. Fundamentals of electronics and physics

Content of the material:

The practical work can be organized in three parts: modeling/simulation, analysis and synthesis. The content of this module and the number of practical exercises to be carried out can be adjusted according to the equipment available in the laboratory. Simulations can be used to reinforce practical tests or to fill in the equipment gap.

Part 01: PC simulation lab (theoretical part)

Lab N°1: Solving differential equations representing the dynamics of systems (electrical, mechanical and electromechanical) using the Matlab software

Use of Matlab software commands such as: *ode45*, *ode123*, *Order4 Rank-Kutta*, ... etc.

Lab N°2: Determining the transfer function of a system and plotting temporal and frequency responses

Use of the commands*: Ident, Step, Impulse, Lsim, Ltiview, Bode, Nyquist,...*etc.

Lab 3: Improving the Performance of a Looped System - Introduction to Simulink Software

Define Simulink tools such as: *scope*, *source*, *comparator*, *step*, *pure delay*, *transfer function*, *perturbation*, *measurement noise*,... etc.

Use the *RLTOOL* command to synthesize the controller that stabilizes the transfer function.

Improve the performance of the looped system by adding poles and zeros to the corrector provided by the RLTOOL command.

Part 02: Practical validation

Lab N°1: Modeling and identification of an R-L-C electrical circuit by a first/second order model (random excitation by a voltage generator and measurement of the output voltage by a voltmeter). The same goes for the two temperature sensors NTC and PT100.

Lab N°2: Study of a PID corrector made using operational amplifiers.

Lab N°3: Temperature regulation by an ALL or NOTHING.

Lab N°4: Adjustment of a first-rate system by a P and PI regulator.

Lab N°5: Adjustment of a second-order system by a P, PI and PID regulator.

Lab N°6: Adjusting the speed of a DC motor.

Method of evaluation:
Continuous assessment: 100%.

Bibliographical references:
1-S. Le Ballois, P. Codron, Automatique: Systèmes linéaires et continus, Dunod 2006.
2- P. Prouvost, Automatique - Contrôle et régulation Cours, exercices et problèmes correctes, Dunod 2010.
3- E. Godoy, Industrial Regulation, Modeling Tools, Control Methods and Architectures, Dunod.

Semester: 4
Teaching unit: UEM 2.2
Subject 3: Combinatorial and sequential logic- Lab course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

Consolidate the knowledge acquired during the course of the subject "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 be carried out and dealing with the two types of logic circuits (combinatorial and sequential).

Lab1: TTL and CMOS integrated circuit technology.
Understand and test the different logic gates

Lab2: Simplification of logical equations through practice
Discover the rules of simplifying equations in Boolean algebra through practice

Lab3: Study and realization of usual combinatorial logic functions
Example: switching circuits (MUX, DMUX), coding and decoding circuits, etc.

Lab4: Study and realization of an arithmetic combinatorial circuit
Realization of an adder and/or subtractor circuit of 2 binary numbers with 4 bits.

Lab5: Study and realization of a logical combinatorial circuit
Realization of a logic function using logic gates. Example a 7-segment display and/or a generator of the complement to 2 of a 4-bit number and/or generator of the 4-bit Gray code, ...

Lab6: Study and realization of a logical combinatorial circuit
Complete study (Truth Table, Simplification, Flowchart, Practical Assembly and Tests) of a combinatorial circuit based on a specification.

Lab7: Study and construction of meter circuits
Incomplete asynchronous counter circuits using toggles, Irregular cycle synchronous counter circuits using toggles

Lab8: Study and production of registers

Method of evaluation:

Continuous assessment: 100%

References:

1. J. Letocha, Introduction to Logic Circuits, Mc-Graw Hill Edition.
2. J.C. Lafont, Courses and Problems in Digital Electronics, 124 Exercises with Solutions, Edition Ellipses.

Semester: 4
Teaching unit: UEM 2.2

Subject 4: Numerical methods- Lab Course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

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

Recommended Prior Knowledge

Numerical method, Computer Science 2 and Computer Science 3.

Content of the material:

Chapter 1: Solving nonlinear equations **3 weeks**

1. Method of bisection. 2. Fixed-point method, 3. Newton-Raphson method

Chapter 2: Interpolation and approximation **3 weeks**

1. Newton's interpolation, 2. Chebyshev's approximation

Chapter 3: Digital integrations **3 weeks**

1. Rectangle Method, 2. Trapezoid method, 3. Simpson's Method

Chapter 4: Differential equations **2 weeks**

1. Euler's method, 2. Runge-Kutta methods

Chapter 5: Systems of linear equations **4 weeks**

1. Gauss-Jordon's method, 2. Crout decomposition and factorization LU, 3. Jacobi's method, 4. Gauss-Seidel method

Method of evaluation:

Continuous assessment: 100%.

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: a guide to computation, programming and graphical representations; in accordance 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: Architecture of Automated Systems
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

Introduce students to Industrial Automated Systems (AS) and their Architecture. To know the constituent bodies of the SA and their operating principles. This program is an introduction to different subjects of semesters five and six where they will be detailed.

Recommended prior knowledge:

Content of the material:

Chapter 1: Introduction (2 weeks)

Global approach to a production system, Objectives of production automation, Profitability of automation, Example of application.

Chapter 2: Structure of a Production System (3 weeks)

Decomposition of the OPERATIVE PART and the CONTROL PART (PO – PC), Elements of the P.O. and the P.C., Effector, Actuator (electric motor, pneumatic cylinder, ...), Pre-Actuator (contactors, relays, pneumatic distributors), Sensor (TOR sensors, analog sensors, transmitters), Processing (PLC, industrial PC...), Dialogue (HMI, SCADA...).

Chapter 3: Ordering part (2 weeks)

PC Type, Architecture, Programming

Chapter 4: Production Systems Architecture (3 weeks)

Stand-alone machines, Associated machines in line, Centrally controlled production cell, Decentralized and coordinated control cell, Flexible cell with distributed and hierarchical control.

Chapter 5: Notions of networks (2 weeks)

Industrial local area networks, Computer networks.

Chapter 6: Presentation and Case Study (3 weeks)

Electrical distribution, Petrochemical Process Control, Thermal, furnaces, ...

Remark:

Favor an animated presentation using slides and videos,
Plan and organize a visit to the industrial site, if possible.

Assessment method: Final exam: 100%.

Bibliographical references:

1- Industrial Process Management Architectures AG3510 Engineering Technology
2- Automation and industrial processes in the food industry Engineering technology

F1290
3- Programmable Logic Controllers Engineer S8015
4- Jean-Pierre THOMESSE, Local industrial networks - Concepts, typology, technical characteristics of the engineerRef.S7574v1

Semester: 4
Teaching unit: UED 2.2
Material 2: Electrical Safety
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

The purpose of the subject is to inform the future licensee about the nature of electrical accidents, the methods of rescue of electrical accident victims and to give him sufficient knowledge to enable him to best size the protective devices for equipment and personnel involved in industry and other areas of use of this equipment.

Recommended prior knowledge:

Notions of electricity.

Material content:

Chapter 1: Electrical hazards (2 weeks)

Definition and purpose of occupational safety, Legend and history of electrical risk, Standardization organization, Statistics on electrical accidents.

Chapter 2: Nature of Electrical Accidents and Dangers of Electric Current (3 weeks)

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

Chapter 3: Safeguards (6 weeks)

Introduction, Protection of persons, Regulations, Safety measures, De-energized work, Work in the vicinity of electrical installations, Personal and collective protection, Protection against direct and indirect currents, Safety voltage, Grounding diagram (SLT), Effects of the electric and magnetic field, Protection of equipment, Protective devices (types and reliability of devices), LV indoor installations, MV and HV, LV mobile devices, Checks and controls.

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

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

Chapter 5: Relief measures and care (2 weeks)

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

Method of evaluation:

Final exam: 100%.

Bibliographical references:

1-V. Semeneko, General Requirements for Technical Safety in a Company, University of Annaba, 1979.
2- A. Novikov, Cahier de Cours de Protection de Travail, University of Annaba, 1983.
3- Edgar Gillon, Cours d'Electrotechnique, Dunod, Paris 1966.
4- Encyclopédie des Sciences industrielles, Quillet, Paris, 1983.
5- L.G. Hewitson, Guide to the Protection of Electrical Equipment, Dunod, 2007.

Semester: 4
Teaching unit: UET2.2
Subject:Expression, information and communication techniques
VHS:22:30 (Lesson: 1h30)
Credits:1
Coefficient:1

Teaching objectives:

This course 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 communication.

Recommended prior knowledge:

Languages (Arabic; French; English)

Material content:

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

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

Chapter 3: Develop autonomy, organizational and communication skills as part of a project approach (2 weeks)
Situate oneself in a project and communication approach, Anticipate action, Implement a project: Presentation of a report of a practical work (Homework).

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

Chapter 5: Retrieval, Use and Retrieval of Information. (2 weeks)
Search directories (YAHOO, GOOGLE), Search engines, Query and search language, Retrieving and printing an HTML page, Retrieving an image, Downloading a file or software, Reading an HTML file locally, Reading 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, protecting confidential data and preserving nuisances. (3 weeks)
Safeguarding important data, Data Protection Act, 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 or Spam, Hoaxes, Cryptology, Electronic Signature....

Evaluation method:

Final exam: 100%.

References:

(Books and handouts, websites, etc.)

1. Jean-Denis Commeignes, 12 methods of written and oral communication – 4th edition, Michelle Fayet and Dunod 2013.
2. Denis Baril, Sirey, Techniques de l'expression écrit et orale, 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 JorbaLaja (edited by). Digital Media and Political Engagement Worldwide. Cambridge UniversityPress - M.U.A, 2012. ISBN-10: 1107668492; ISBN-13: 9781107668492
6. Baron G.L., and Bruillard E. Computer science and its users in education. Paris, PUF, 1996. ISBN-10: 2130474926; ISBN-13: 978-2130474920
7. Online: Chantepie P. and Le Diberder A. Digital Revolution and Cultural Industries. Marks. 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. Greenfield David. "The Addictive Properties of Internet Usage". In Internet Addiction, 133-153. John Wiley & Sons, Inc., 2007. ISBN: 9780470551165. http://dx.doi.org/10.1002/9781118013991.ch8.
11. Kurihara Yutaka 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 the prescribed to the customs. 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
Topic 1: Control of linear systems

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

Teaching objectives:

This module is a consolidation of the knowledge acquired in the second year and allows the mastery of the representation of dynamical systems and their properties in state space as well as the acquisition of the main methods of analysis and synthesis of control systems.

Recommended prior knowledge:

Basic mathematics. Continuous and sampled linear systems.

Material content:

Chapter 1. Calculation of controllers in the frequency domain (4 weeks)
Frequency response and frequency properties of controllers (P, PI, PID, PD, phase advance, phase delay, phase advance), Specification in the frequency domain (gain and phase margin, resonance factor, bandwidth, their interpretations), Calculation of controllers using the Bode diagram, Adjustments using the Black-Nichols chart.

Chapter 2. System Status Representation (2 weeks)
Introduction, Concepts (state, state variables, ...), State representation of continuous linear systems, State representation of discrete systems, Canonical forms, State representation of nonlinear systems, Linearization.

Chapter 3. Analyzing systems in the state space (3 weeks)
Solving equations of state and transition matrix, Transition matrix calculation methods, Modal analysis (diagonalization), Stability, Notions of commandability and observability (definitions and test methods).

Chapter 4. Status feedback control (3 weeks)
Formulation of the Pole Placement Problem by State Feedback, Computational Methods for Monovariable Systems, Cases of Multivariate Systems, Implementation.

Chapter 5. Summary of the status observers (3 weeks)
Introduction, Deterministic observers (Luenberger) and calculation methods, Reduced observers, Stochastic observers (Kalman filter).

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. Philippe de Larminat, "Automatique: Commande des systèmes linéaires", Hermès Lavoisier, 1996.
2. Hubert Egon, "Sampled Linear Servoing and State Representation", Methods, 2001.
3. Luc Jaulin, "Représentation d'état pour la modélisation et la contrôle des systèmes", Lavoisier, 2005.
4. Robert L. Williams, Douglas A., "Lawrence, Linear State-Space Control Systems," John Wiley & Sons Edition, 2007.
5. R. Longchamp, "Numerical control of dynamic systems", Presses Polytechniques et Universitaires Romandes, 1995.
6. G. F. Franklin, J. D. Powell, L. M. Workman, "Digital control of dynamic systems", Addison-Wesley Series in Electrical and Computer Engineering: Control Engineering, 1990.
7. K. J. Aström, B. Wittenmark, " Computer controlled systems: theory and design", Prentice-Hall, 1984.
8. R. H. Middleton, G. C. Goodwin, " Digital control and estimation: a unified approach", Prentice Hall, 1990.

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

Teaching objectives:

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

Recommended Prior Knowledge

Fundamental Electronics1, Fundamental Electrical Engineering1.

Content of the material:

The number of weeks displayed is given as an indication. It is obvious that the course leader is not required to strictly respect this sizing or the arrangement of the chapters.

Chapter 1. Introduction to Power Electronics **3 Weeks**

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

Chapter 2. AC to DC converters **3 Weeks**

Power Elements (Diodes and Thyristors), Single-Phase Rectifier, 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 **3 Weeks**

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

Chapter 4. Direct current to direct current converters **3 Weeks**

Power elements (GTO thyristor, bipolar transistor, MOSFET transistor, IGBT transistor), step-down chopper and booster, with R, RL and RLE load.

Chapter 5. Direct current to alternating current converters **3 Weeks**

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

Method of evaluation:

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

References:

1. L. Lasne, "Power Electronics: Courses, Case Studies and Corrected Exercises", Dunod, 2011.
2. P. Agati et al. "Aide-mémoire: Electricity-Control and Power Electronics–Electro-technique", Dunod, 2006.
3. J. Laroche, "Power Electronics – Converters: Corrected Courses and Exercises", Dunod, 2005.
4. G. Séguier et al. "Power Electronics: Corrected Courses and 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 and Doc.
7. H. Bühler, "Power Electronics", Dunod
8. C.W. Lander, "Power Electronics," McGraw-Hill, 1981

9. H. Bühler, "Electronics of Adjustment and Control; Traité d'électricité ».
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, "Controls of direct current motors (Power electronics)", 1984.

Semester: 5
Teaching unit: UEF 3.1.1
Subject 3: Modelling and identification of systems
VHS: 10:30 pm (Lecture: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

The objective of this course is to present fundamental notions and basic methods that allow an automation engineer to develop representation models describing the input-output behavior of a process to be controlled in order to develop an efficient regulator.

Recommended prior knowledge:

Basics in Mathematics and Slave Systems.

Material content:

Chapter 1. Modeling **(3 weeks)**

Representation model, Knowledge model (modeling of mechanical, electrical, fluidic, thermal systems, etc.).

Chapter 2. Reminder of the basic methods in Automatic **(4 weeks)**

Temporal response of a system, Direct identification from the temporal response, Frequency approach.

Chapter 3. Model fit principle **(4 weeks)**

Linear model with respect to parameters, Minimization of the fit criterion and calculation of the optimal solution, Matrix writing of the least-squares method.

Chapter 4. Analysis of the method of the leastSquare **(3 weeks)**

Estimation bias, Variance of the estimate, Estimator of the maximum likelihood, Rejection of outliers.

Chapter 5. Recursive Least Squares **(1 week)**

Principle of recursive calculus, Implementation of the recursive method, Weighting factor, Forget factor.

Evaluation method:

Review: 100%.

Bibliographical references:

1. Jean-François Massieu, Philippe Dorléans, "Modélisation et analyse des systèmes linéaires", Ellipses, 1998.
2. Pierre Borne, Geneviève Dauphin-Tanguy, Jean-Pierre Richard, "Modeling and Process Identification", Technip, 1992.
3. Ioan D. Landau, "Identification of Systems", Hermès, 1998.
4. E. Duflos, Ph. Vanheeghe, "Estimation Prédiction", Technip, 2000.
5. R. Ben Abdenour, P. Borne, M. Ksouri, M. Sahli, "Identification and numerical control of industrial processes", Technip, 2001.

Semester: 5
Teaching unit: UEF 3.1.2
Subject 1: Microprocessors and Microcontrollers
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

This course provides students with an understanding of how microprocessors work, their peripherals, and how they interface. It also allows them to become familiar with the different types of ECUs used in industrial facilities.

Recommended prior knowledge:

Combinatorial and sequential logic, Notions of programming.

Material content:

Chapter 1. Microprocessor architecture (2 weeks)

Introduction to Microprocessor-Based Systems, External Architecture of a Microprocessor, Internal Architecture of a Microprocessor.

Chapter 2. Introduction to the instruction set and interrupts (4 weeks)

The instruction set, The mnemonic code, The addressing modes, The interrupts.

Chapter 3. Memoirs (2 weeks)

Introduction, Memory Technology: ROM, RAM, Refresh Techniques, Memory Characteristics, Addressing Modes.

Chapter 4. Interfaces (2 weeks)

Serial interface, Parallel interface.

Chapter 5. The microcontroller (5 weeks)

General information on the microcontroller, Microcontroller architecture, Peripherals, Interrupts, Microcontroller programming, Practical application.

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. A. Farouki, T. Laroussi, T. Benhabiles, "Microprocessors 8086", Univ. Constantine.
2. J. Y. Haggège, "Microprocessor: Course Support", INSET, 2003.
3. Lilen, "Cours fondamentale des microprocessors", Dunod, 1993.
4. Alain-Bernard Fontaine, "Le Microprocessor 16 bits-8086-8088", 2nd edition, Manuels informatiques", Masson, 1997.
5. Michel Aumiaux, "Microprocessors 16 bits", 1997.
6. J. Crisp, "Introduction to microprocessors and microcontrollers", Elsevier, 2nd edit 2004.
7. Christian Tavernier, "Microcontrollers PIC 10, 12, 16, Description and implementation", Dunod, 2007.
8. Pascal Mayeux, "Learning Mid-Range ICP Programming through Experimentation and Simulation", Dunod, 2010.

Semester: 5
Teaching unit: UEF 3.1.2
Subject 2: Programming in C++
VHS: 10:30 pm (Lecture: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

This course will allow the student to become familiar with programming languages and in particular the C++ language.

Recommended prior knowledge:

Basics in mathematics, Notions of algorithmics, Numerical methods, Binary logic.

Material content:

Chapter 1. Introduction to the C++ language (1 week)
History, Development environment in C++ (creation of objects, compilation, debugging, execution...).

Chapter 2. Syntax elementary in C++ language (1 Week)
Instructions Comments, Keywords and Reserved Words – Constants and Variables, Fundamental Types Operators (Unitary, Binary, Priority,...).

Chapter 3. Conditional Structures and Loops (2 weeks)
If/else, Switch/case, Loop for, Loop while, Loop do/while.

Chapter 4. Inputs/outputs (2 weeks)
Output stream for display, Keyboard input stream, Case of strings, files.

Chapter 5. Pointers and Tables (2 weeks)
Pointers, References, Static Arrays, Arrays and Pointers, Dynamic Arrays, Multidimensional Arrays.

Chapter 6. Duties (2 weeks)
Prototype a Function, Define a Function, Call a Function, Pass Arguments to a Function, Override a Function, Files.

Chapter 7. Object-Oriented Programming in C++ (5 weeks)
Introduction, Concept of classes and objects, Inheritance, Special methods (constructors, destructors...), Procedural or structured programming, Object-based programming.

Evaluation method:

Review: 100%.

Bibliographical references:

1. Bjarne Stroustrup, Marie-Cécile Baland, Emmanuelle Burr, Christine Eberhardt, "Programming: Principles and Practice with C++", Pearson Edition, 2012.
2. Jean-Cédric Chappelier, Florian Seydoux, "C++ through practice. Collection of corrected exercises and aide-mémoire", PPUR Edition: 3rd edition, 2012.
3. Jean-Michel Léry, Frédéric Jacquenot, "Algorithmics, applications to C, C++ languages in Java", Pearson Edition, 2013.
4. Frédéric DROUILLON, "From C to C++ - From procedural programming to the object", Eni; Edition: 2nd edition, 2014.
5. Claude Delannoy, "Programming in C++ language", Edition Eyrolles, 2000.
6. Kris Jamsa, Lars Klander, "C++ The Programmer's Bible", Edition Eyrolles, 2000.
7. Bjarne Stroustrup, "The C++ Language", Addison-Wesley Edition, 2000.

Semester: 5
Teaching unit: UEM 3.1.1
Material 1: Ordering linear systems- Lab Course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

Consolidate the knowledge acquired during the course of the corresponding theoretical subject through practical work.

Recommended prior knowledge:

Continuous servo systems, Study of systems in the frequency domain and in state space.

Material content:

Lab 1: Getting Started with MATLAB/Simulink

Lab2: Study and synthesis of regulators in the frequency domain

Lab3: The representation of state in canonical forms

Lab4: Study and analysis of systems in state space

Lab5: Study and synthesis of regulators by pole placement

Lab6: Study and synthesis of the state observers

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Teaching unit: UEM 3.1.1
Subject 2: Power Electronics – Lab course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

The aim is to understand the operation and characteristics of the different types of basic converters and their applications to machines.

Recommended prior knowledge:

Content of the Power Electronics course.

Material content:

Lab N° 1. Non-controlled rectifiers: single-phase and three-phase
Analyze the evolution of the voltage and current at the ouLabut of the converter with resistive and inductive loads, Analyze the evolution of the semiconductor currents and voltages in both the case of resistive and inductive loads, Determine the form factor and the ripple rate.

Lab N° 2. Controlled, single-phase and three-phase rectifiers
Analyze the evolution of the voltage and current at the output of the converter with resistive and inductive loads, Analyze the evolution of the semiconductor currents and voltages in both the case of resistive and inductive loads, Determine the form factor and the ripple rate.

lAB N° 3. Choppers, Serial Chopper, Parallel Chopper
To study the behaviour of a series chopper on the inductive load and in particular to determine the shape of the current absorbed by the load during operation in a transient and then a steady state, To understand the operation by observing the characteristic signals of the assembly and comparing them to the results of the TD on the parallel chopper.

lAB N° 4. Single-phase inverters
To study the operation of single-phase voltage inverters and on the other hand the filtering of the waveforms obtained. "Active" and "passive" filtering solutions will be discussed.

lAB N° 5. Single-phase and three-phase dimmers
To study the operation of a dimmer dispensing different types of loads (R and R-L) and to compare the different results obtained theoretically in class with the practical results (formulas and chronograms).

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Teaching unit: UEM 3.1.1
Subject 3: Modelling and identification of systems- Lab Course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

The purpose of these labs is to put into practice the modeling and identification methods presented in the course.

Recommended prior knowledge:

The student must be proficient in computer tools, in particular simulation by the MATLAB Simulink toolbox, Modeling and System Identification course.

Material content:

Lab1: Introduction to MATLAB/Simulink

Lab2: Simulation of a System Described by the Equation of State and Transfer Function (Simulink)

Lab3: Nonparametric identification by the deconvolution method

Lab4: Nonparametric identification by the Correlation Method

Lab5: Parametric identification by the Broida method

Lab6: Least Squares Method

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Teaching unit: UEM 3.1.2
Subject 1: Microprocessors and Microcontrollers- Lab course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

Acquire the ability to implement a small system based on microcontrollers and microprocessors through the knowledge of the main families and the operation of a microcontroller and its peripherals.

Recommended prior knowledge:

Basic knowledge of digital electronics (Boolean logic, logic gates, toggles, counters, registers), Computer architecture, Knowledge of an assembly language.

Material content:

Lab1: Getting started with the 6809/8086 emulator

Lab2: Arithmetic and logical operations on the microprocessor

Lab3: Application of the different addressing modes

Lab4: Interruptions

Lab5: Learning to program with a PIC 16F84

Lab6: Controlling a display (7 segments, LCD)

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Teaching Unit: UEM 3.1
Subject 2: Programming in C++ - Lab Course
VHS: 3:00 pm (Lab Session: 1:00 am)
Credits: 1
Coefficient: 1

Teaching objectives:

This module will allow the student to put into practice and consolidate the knowledge acquired in the C++ programming module.

Recommended prior knowledge:

C++ programming module

Material content:

Lab 1: Familiarization with theC++ language
(Development environment , compilation, debugging, execution...)

Lab 2: Basic syntax,declaring variables and operators

Lab 3: Conditional structures and loops

Lab 4: Tables and Pointers

Lab 5: Functions

Lab 6: Files

Lab 7: Object-Oriented Programming in C++
Classes, Special Methods (Constructors, Destructors...), Inheritance

Evaluation method:

Continuous assessment: 100%.

Semester: 5
Teaching unit: UED 3.1
Subject 1: Standards and Certification
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

The objective of this course is to give the student the basic elements to understand what an industrial standard and certification is, while explaining the differences, levels and types of existing certifications and the institutions that can issue such certificates.

Recommended prior knowledge:

No.

Material content:

Chapter 1. Introduction (1 week)
- Definitions (ISO/IEC 2 2004 guide) Standardization, norm, standard, consensus. Feedback

Chapter 2. Standardization Objectives and Standardization Benefits (1Week)
- Reminder of the history of quality: from craftsmanship to the digital industry
-Quality and quality assurance
-Roles of standardization
- Advantages of a quality system (ISO 9000 for example)

Chapter 3. Trade legislation (1 week)
- Law, decree, circular, etc., regulatory text and standard
- Standardization and economic actors
Examples: PC vs. Apple computer, IBM PC vs. PC compatible
-Quality control and compliance laboratories
- Border control: health, product quality, health impacts, economic techniques , policies (protectionism)

Chapter 4. Types of standards and organization of standardization work (2 weeks)
-Notion of voluntary norm
- Internal or local organizations: European and American organizations, Algerian organizations
- International organizations: CGPM and the SI system, ISO, EN standards, specific standards in electricity and telecommunications

Chapter 5. Standards development, standardization and safety (3 weeks)
- Manufacture of standards: the case of Afnor and Ianor, organization and functioning of Algerian standardization, process of elaboration of Algerian standards
- Main legal texts relating to standardization in Algeria
-Standardization and security
-Applications to domestic electrical security:
- Realization of a compliant domestic electrical installation (example of the nfc18510 standard): distribution of circuits (according to their use), choice of wire sections and line circuit breakers.
- Realization of the earthing connection according to standards

Chapter 6. Certification (4 weeks)
-Accreditation

-Certification
-Different types of certification most common in Algeria (and partly financed by the state)
-Certification process

Chapter 7. ISO 9000 standards **(2 weeks)**

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Description-The ISO 9000 Family
- Scope of the different ISO 9000 standards
- Important notes on ISO 9001:2015 and ISO 9004:2015

Evaluation method:

Review: 100%.

Bibliographic reference:

1. Robert Obert, "Pratique des normes IFRS, Comparison avec les règles françaises et les US GAAP", Dunod, 2004.
2. Daniel Boeri, Mastering Quality: All About Certification and Total Quality, Editions Maxima, 2003, p. 26. (ISBN 2840013134)
3. ISO 9000:2015 "Quality Management System – Essential Principles and Vocabulary"
4. Standard, ISO 9001:2015 "Quality Management System – Requirements
https://fr.wikipedia.org/wiki/S%C3%A9rie_des_normes_ISO_9000
5. Appendix D: accreditation, retraining, ED6127 standard: general training and retraining scheme for accreditation in the nfc18510_inrs_habilitation standard.
6. 2014 Catalogue of Algerian Standards pdf document 447 pages (free download)
http://www.ianor.dz/Site_IANOR/Catalogue.php?id=8
7. List of Bodies accredited by Algerac: certification, inspection, tests-analyses, etc. (updated14/09/2017)

Semester: 5
Teaching unit: UED 3.1
Material 2: Renewable Energies: Production and Storage
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

This course allows the student to know the principles of electricity production from renewable energies, in order to be able to propose renewable alternatives for the production of electrical energy.

Recommended prior knowledge:

Energy and environment courses

Material content:

Chapter 1. General information on energy **(3 weeks)**
Definition, measurement, power and energy.

Chapter 2. The different types of energy and their transformation **(3 weeks)**

Chapter 3. Main sources of electricity production **(3 weeks)**
Fossil and renewable.

Chapter 4. Principle of production from solar and wind power **(2 weeks)**

Chapter 5. Stand-alone energy sources with storage systems **(4 weeks)**
Batteries, capacitors, others.

Evaluation method:

Review: 100%.

Bibliographical references:

1. Jean-Christian Lhomme, Alain Liébard, "Renewable Energies", Delachaux & Niestlé, Edition: 2nd edition, 2004.
2. Leon Freris and David Infield, "Renewable Energies for Electricity Production", Dunod, 2013.
3. Philippe Terneyre, "Renewable Energies: Implantation Contracts: Location of Production Units, Supensive Clauses, Contract Models", Sa Lamy, April 2010.
4. Michel Lavabre and Fabrice Baudoin, "Energy conversion exercises and problems: Volume 5, Renewable energies (1): wind turbines, energy management and storage", Casteilla, 2010.

Semester: 5
Teaching unit: UET 3.1
Subject 1: English in Automatic Testing
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Describe automatic equipment, how it works and its applications, Express oneself on automation in general, Use the appropriate technology and adapted grammatical structures, Deepen one's general culture, Understand a current and general interest document.

Recommended prior knowledge:

English 1 and 2.

Material content:

Chapter 1. Reminder of English grammatical rules **(3 weeks)**
Reminder of the English grammatical rules.

Chapter 2. Terminology used in the field of Automation **(3 weeks)**
Terminology used in the field of automation, The use of technical tutorials.

Chapter 3. Study of technical texts **(3 weeks)**
Study of technical texts in the field of automation, Reading scientific or general articles.

Chapter 4. Working on a variety of technology supports **(2 weeks)**

Chapter 5. Reporting Techniques and Synthesis Briefs (4 Weeks)
Elaboration of a presentation on the theme of Automation. This activity allows learners to build a presentation and deliver it in English in front of their peers. This activity has one condition: it must be developed in pairs. This implies collaborative work. It also allows for a classroom debate on the theme presented.

Evaluation method:

Review: 100%.

Semester: 6
Teaching unit: UEF 3.2.1
Material 1: Sampled Servo Systems
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

To know the techniques of sampling and signal reconstruction, To be able to study the stability and evaluate the accuracy of a sampled slave system, To apply some methods of analysis and synthesis of sampled slave systems.

Recommended prior knowledge:

Linear and continuous servo systems, Basic mathematics (Algebra, analysis, ...).

Material content:

Chapter 1. Structure of a numerical control system (1 week)
History, Advantages and Disadvantages of CNC Control, General Structure of a CNC System, A/D and D/A Conversions, Samplers/Blockers.

Chapter 2. Signal sampling (2 weeks)
Modeling of A/D and D/A Converters, Sampling, Signal Construction, Blockers, Z-Transmittance and Frequency Response of a BOZ (Zero-Order Blocker), Shannon's Sampling Theorem, Practical Considerations.

Chapter 3. Representation of sampled systems (3 weeks)
Definitions, Representation by Difference Equations, Advance/Delay Operators, Representation by Impulse Response, Z Transform, Z-Transmittance and Block/Diagram Simplification, Poles/Zero Transformation by Sampling.

Chapter 4. Analysis of sampled systems (4 weeks)
Stability conditions, Temporal nature of transient signals, Stability criteria (Schur-Cohn, Jury, Routh-Hurwitz, Discrete Nyquist, Discrete Evans Place).

Chapter 5. Summary of sampled systems (4 weeks)
Introduction, Speed, Static Accuracy, PID Standard Controllers, Synthesis in the P Plane and Scanning, Synthesis in the Z Plane, Practical Implementation of Controllers.

Chapter 6. RST Controller (1 week)

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. J.R. Ragazzini, G. F. Franklin, "Sampled Servo Systems", Dunod, 1962.
2. Daniel Viault, Yves Quenec'hdu, "Sampled Servo Systems", ESE, 1977.
3. Christophe Sueur, Philippe Vanheeeghe, Pierre Borne, "Automation of sampled systems: course elements and solved exercises", Technip, December 5, 2000.
4. P. Borne. G.D.Tanguv. J. P. Richard. F. Rotella, I. Zambetalcis, "Analysis and regulation of industrial processes-numerical regulation", Volume 2-Editions Technip, 1993.
5. Emmanuel Godoy, Eric Ostertag, "Numerical Control of Systems: Frequency and Polynomial Approaches", Ellipses Marketing, 2004.

Semester: 6
Teaching unit: UEF 3.2.1
Material 2: Actuators
VHS: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

The objective of this course is to enable learners to acquire the knowledge necessary to choose the components of the pneumatic, hydraulic, electrical and thermal operating parts. It will also allow them to understand the challenges and solutions available in the field of industrial automation actuators.

Recommended prior knowledge:

Power Electronics, Fundamental Electronics1, Fundamental Electrical Engineering1.

Material content:

Chapter 1: Reminders (2 weeks)

Reminders: Operational and control parts of an automated system, Structure of an automation in pneumatic, electrical, electronic technologies

Interfaces: Interfaces that modify the parameters of a signal; Interfaces that change the nature of a signal

Chapter 2- Pneumatic actuator: The cylinder (2 weeks)

1-Description. 2-Sizing. 3-Limit switches. 4-Different types of cylinders. 5-Example application

Chapter 3 - Precautions for pneumatic actuators: The distributor (2 weeks)

1-Means of control or control. 2-Standardized symbols. 3-Electro dispensers. 4-Distribution auxiliaries. 5-Example of application.

Chapter 4- Electric actuator: The motor (3 weeks)

1- DC motor. 2- Single-phase motor. 3- Stepper motor. 4- Three-phase asynchronous motor.

Chapter 5- Precautionary for electric actuator (2 weeks)

1-Manually operated switchgear: the circuit breaker and the motor circuit breaker. 2-Automatically controlled switching device: the contactor. 3-Electronically controlled switching device: the electronic inverter.

Chapter 6- Recalls: the motor in an electrical installation (1 week)

1-Single-phase and three-phase power supply network. 2-Functional structure of an electrical installation (power and control parts and the different functions). 3-Function of disconnecting or isolating the installation (the disconnector). 4-Power circuit protection (against short circuits, overcurrents, overloads). 5- Switching function. 6-Control circuit protection.

Chapter 7- Three-phase motor control (3 weeks)

1-Coupling of the stator (star, triangle). 2-Rotor coupling (cage or short-circuited, rotor wound). 3-Starting modes (direct, star-triangle, stator resistors, rotor resistors). 4- Braking of three-phase asynchronous motors. 5-Different types of control (manual, semi-automatic, automatic). 6- Example of synthesis:1 - Semi-automatic control -2- Automatic control by PLC.

Evaluation method:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. Guy Clerc, Guy Grellet, "Electric-Actuators, Models, Control", Eyrolles, 1999.
2. Gérard Lacroux, "Electric Actuators for Robotics and Servos", 1994.
3. Pierre Mayé, Industrial Electric Motors, Dunod, 2011.
4. J. Faisandier, "Hydrauliques et pneumatiques", Dunod 1999.
5. R. LABONVILLE, "Conception des circuits hydrauliques, une approche énergétique", Editions de l'Ecole Poly technique de Montréal 1991.
6. P. MAYE, "Electric Motors for Robotics", Dunod Paris 2000.
7. José RoldanViloria, Aide-mémoire de pneumatique industrielle, Dunod, 2015.

Semester: 6
Teaching unit: UEF 3.2.1
Topic 3: Sensors and measurement chains
VHS: 10:30 pm (Lecture: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

After acquiring this unit, the student is expected to master the different elements of a measurement chain, the basic operating principle of a sensor and the metrological characteristics that must be taken into account when using and choosing a sensor.

Recommended prior knowledge:

General Electricity, Electrical and Electronic Measurements.

Material content:

Chapter 1. Notions of measurement chain: (1 week)
Definition, synoptic diagram of an industrial control chain, active and passive sensors, classification of sensors.

Chapter 2. Metrological characteristics of the sensors: (1 week)
Definition, sensor calibration, sensitivity, linearity, accuracy, dynamic sensitivity.

Chapter 3. Sensor conditioning circuit: (3 weeks)
Basic assemblies of operational amplifiers (inverter, non-inverter, differential, summator, etc.). Instrumentation Amplifier, Isolation Amplifier. Conditioning bridges . Linearization of static sensor characteristics.

Chapter 4. Temperature measurement: (3 weeks)
Introduction to Thermometry, Resistance Thermometry, Thermocouple, Thermistor, Pyrometer.

Chapter 5. Pressure measurement: (2 weeks)
Notions of pressure, absolute pressure, relative pressure and differential pressure.
Piezoresistive pressure sensors

Chapter 6. Measurement of levels and flows: (3 weeks)
Float Sensors, Ultrasonic Doppler Sensors

Chapter 7. Measurement of displacements and speed: (2 weeks)
Optical encoders, Incremental encoders, Variable reluctance sensors.

Evaluation method:

Review: 100%.

Bibliographical references:

1. George Asch et Coll, "Sensors in Industrial Instrumentation", 6th edition Dunod, 2006.
2. Pascal Dassonvalle, "Sensors: 50 Corrected Exercises and Problems", Dunod, 2004.
3. Georges Asch, Patrick Renard, Pierre Desqoutte, Zoubir Mammeri, Eric Chambérod, Jean Gunther, "Data Acquisition", 3rd edition, Dunod, 2011.
4. Fèrid Bélaïd, "Introduction to Sensors in Industrial Instrumentation", University Publication Center 2006.
5. J. P. Bentley, "Principles of measurement systems", Pearson education 2005.
6. J. Niard et al., "Electrical Measurements", Nathan, 1981.

Semester: 6
Teaching unit: UEF 3.2.2
Material 1: Programmable logic controllers
VHS: 67h30 (Lecture: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

Identify the technological elements that make it possible to control the operation and monitor an automated production system, Use the tools for specifying an industrial automation system in order to predict a cycle time or a production rate.

Recommended prior knowledge:

Basics of the calculator and programming.

Material content:

Chapter 1. General information on automated systems (2 weeks)
Description of the different parts, Different types of control, Application areas of automated systems.

Chapter 3. The Grafcet (3 weeks)
Description of the Grafcet, Rules of evolution of the Grafcet, Basic structures, Modes of on/off.

Chapter 4. Architecture des API (3 weeks)
PLC Technology, PLC Environment, External Appearance, Internal Structure, Criteria and Selection of PLCs, PLC Wiring to the Different I/O and Interfaces of an SAP (Automated Production System)

Chapter 5. Programming an API (7 weeks)
PLC program processing and execution cycles, Different programming languages (Ladder or contact, Boolean or Logical or List Mode, Graph or Flowchart, SFC or grafcet), single-sequence grafcet programming, multi-sequence grafcet programming.

Method of evaluation:

Continuous assessment: 40%; Examination: 60%.

Bibliographical references:

1. Hamdi Hocine, "Logical Automatisms: Modeling and Control", volumes 1 and 2, Éditions de L'UMC, 2006.
2. William Bolton, "Industrial programmable automata", Dunod, 2010.
3. J.C. Humblot, "Industrial programmable automata", Hermes Science Publications, 1993.
4. Simon Moreno, Edmond Peulot, "GRAFCET: design, implementation in programmable industrial automatons", Delagrave, 2009.
5. Kevin Collins, "The Programming of Industrial Programmable Automata," Meadow Books, 2007.
6. G. Michel, "Les A.P. I: architecture et applications des automatons programmables industriels ", Dunod, 1988.

Semester: 6
Teaching unit: UEF 3.2.2
Subject 2: Communication Buses and Industrial Networks
VHS: 10:30 pm (Lecture: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

The purpose of this course is to allow the student to become familiar with the concepts of digital data transmission, more particularly the different types of networks existing in the industrial world. The focus will be on understanding the different topologies with their advantages and disadvantages vis-à-vis a given industrial plant.

Recommended prior knowledge:

Notions of bass on Boolian logic.

Material content:

Chapter 1. Network architecture (2 weeks)

- General information on the networks
- Classification of networks
- Network topologies
- Communication Protocols
- Data transmission techniques

Chapter 2. Fieldbus and industrial local networks (3 weeks)

- Industrial Local Area Networks
- Fieldbus Objectives
- Fieldbus classification

Chapter 3. Bus CAN (Controller Area Network) (3 weeks)

- Classification of CAN buses.
- CAN Communication Protocols
- Representation of CAN frames

Chapter 4. : Sensor actuator interface (AS-I) (3 weeks)

- AS-I Fieldbus Architecture
- AS-I Communication Protocols

Chapter 5. ProfiBus field networks (4 weeks)

- ProFiBus network classification
- Profibus and OSI model (communication protocols)
- Principle of access to the bus in a profibus network

Evaluation method:

Review: 100%.

Bibliographical references:

1. Pascal Vrignat, "Local Industrial Networks - Courses and Practical Work", 1999.

2. Jean-François Hérold, Olivier Guillotin, Patrick Anaya, "Industrial Computing and Networks", Dunod 2010.
3. Eric DECKE, "Course module, Local Industrial Networks and Fieldbuses", mimeograph.
4. Tanenbaum, Andrew, "Réseaux", Dunod 4th edition 2003.
5. Stéphane Lohier, Dominique Présent, "Transmissions and networks", Éditions DUNOD
6. Francis Lepage et al., "Les réseaux locaux industriels", Hermes 1991.
7. Fred Halsal, "Mutimedia Communications: Applications, Networks, Protocols and Standards", AddisonWesley, 2001.
8. http://lysjack.free.fr/jack/RLI.htm.

Semester: S6
Teaching unit: UEM3.2
Subject 1: End-of-cycle project – Lab Course
VHS: 45h00 (Lab Session: 3h00)
Credits: 4
Coefficient: 2

Teaching objectives:

Assimilate in a global and complementary way the knowledge of the different subjects. Put into practice the concepts instilled during the training in a concrete way. Encourage a sense of autonomy and initiative in the student. To teach him to work in a collaborative framework by arousing intellectual curiosity in him.

Recommended prior knowledge:

The entire Bachelor's program.

Material content:

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

Remark:
During the weeks during which the students are in the process of immersing themselves in the purpose of their project and its feasibility (bibliographic research, search for software or hardware necessary for the conduct of the project, revision and consolidation of a course with a direct link to the subject, etc.), the subject manager must take advantage of this face-to-face time to remind the students of the essential content of the two subjects.Methodology of writing'' and '' Methodology of presentation'' addressed during the first two semesters of the common core.

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

- The detailed presentation of the subject of study by insisting on its interest in its socio-economic environment.
- The means implemented: methodological tools, bibliographical references, contacts with professionals, etc.
- The analysis of the results obtained and their comparison with the initial objectives.
- Criticism of the discrepancies noted and possible presentation of other additional details.
- Identification of the difficulties encountered by highlighting the limits of the work carried out and the follow-up to be given to the work carried out.

Finally, the student or group of students presents their work (in the form of a brief oral presentation or on a poster) in front of their tutor teacher and a teacher examiner, who can ask questions and evaluate the work done on a technical and presentation level.

Evaluation method:

Continuous assessment: 100%.

Semester: 6
Teaching unit: UEM 3.2
Subject 2: Sensors and Actuators – Lab Course
VHS: 10:30 p.m. (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

These practical exercises allow students to exploit and master the theoretical concepts studied in the course.
Teachers must choose four practical exercises suitable for each subject.

Recommended prior knowledge:

Sensors and measurement chains, Actuators.

Material content:

Practical Sensors

Lab1: Sensor conditioning

Lab2: Temperature measurement

Lab3: Pressure measurement

Lab4: Level measurement and flow rates

Lab5 : Photometric measurement

Lab6: Rotational speed measurement

LAB COURSE Actuators

Lab1: Implementation of a pneumatic system

Lab2 : Control valve

Lab3 : Stepper motor

Lab4: DC and AC motor

Lab5 : Three-phase motor

Evaluation method:

Continuous assessment: 100%.

Semester: 6
Teaching unit: UEM 3.2.1
Material 3: Programmable Logic Controllers- Lab Course
VHS: 10:30 pm (Lab Session: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

Once the student has acquired this material, they will be able to understand and implement a basic automated system. Thanks to the different manipulations, he will be able to program a programmable logic controller to intelligently manage and coordinate the actions planned in the specifications that will be presented to him.

Recommended prior knowledge:

Programmable logic controllers course.

Material content:

Plan some practical work in relation to the programmable logic controllers available.

Evaluation method:

Continuous assessment: 100%.

Semester: 6
Teaching unit: UEM 3.2.1
Subject 4: Communication Bus and Industrial Networks- Lab Course
VHS: 3:00 pm (Lab Session: 1:00 am)
Credits: 1
Coefficient: 1

Teaching objectives:

The purpose of these practical exercises is to put into practice the general methods and techniques of data transmission used in communication networks and to understand the specificities of field networks used in automated production chains.

Recommended prior knowledge:

Courses Communications buses and industrial networks.

Material content:

Plan some practical work in relation to industrial networks according to the means available.

Evaluation method:

Continuous assessment: 100%.

Semester: 6
Teaching unit: UED 3.2
Subject 1: Automatic electrical installations
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

To allow the graduate to have an idea of the choice of power supplies installed according to the type of environment, how to connect them to the process and to the other elements of the control and control system.

Recommended prior knowledge:

General electricity, continuous servo systems, fundamental electrical engineering1.

Material content:

Chapter 1. Power supplies (5 weeks)
Low-voltage distribution, grounding, protection and conditioning interface.

Chapter 2. Standardised electrical switchgear and connection diagrams (6 weeks)

Internal overpressure "p", explosion-proof enclosure, protective devices, control devices, use of sensors, standard symbols, electrical connection of PLCs to actuators, implementation of electrical assemblies.

Chapter 3. Instrument Wiring (4 weeks)
Connections between the various elements of the control system, standard cables, instrumentation cables, cables and safe wiring.

On-site visits (which can be found everywhere) will be welcome to complete the student's training in this very important subject from a practical point of view. These visits could be incorporated into the hourly volume.

Evaluation method:

Review: 100%.

Bibliographical references:

Michel Grout and Patrick Salaun, "Industrial Instrumentation", 3rd edition, DUNOD, 2012.

Semester: 6
Teaching unit: UED 3.2
Subject 2: Maintenance and reliability
VHS: 10:30 pm (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

To know the basic concepts of maintenance and dependability, to become familiar with maintenance methods.

Recommended prior knowledge:

Sensors and measuring chains, actuators.

Material content:

Chapter 1. The maintenance function **(2 weeks)**
Definition, maintenance strategies, maintenance standards

Chapter 2. Failure mechanism and modes **(3 weeks)**
Concept of failure, cause of failure, failure mode, failure mechanisms.

Chapter 3. Quantitative Maintenance Analysis **(4 weeks)**
ABC analysis, Noiret's abacus, Decision tree, criticality matrix, correlation relationships.

Chapter 4. Diagnosis **(4 weeks)**
Definition and methodology, conduct of the diagnosis, diagnostic tools (cause-effects table, fault tree, diagnostic diagram, etc.), comparative study of the tools.

Chapter 5. Predictive Failure Analysis **(2 weeks)**

Evaluation method:

Review: 100%.

Bibliographical references:

1. Jean HENG, "Pratique de la maintenance préventive", Dunod, 2002.
2. Renaud CUIGNET, "Maintenance Management", Dunod, 2002.
3. Introduction to TPM, USINOR, Institut Qualité et Management, 1997.
4. "Practice of autonomous maintenance", USINOR, Institut Qualité et Management 1997.
5. F. MONCHY, Maintenance: methods and organization, Dunod, 2000.
6. J. M. BLEUX, J. L. FANCHON, Maintenance: automated production systems, Collection Etapes, Nathan, 1997.

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

Teaching objectives:

- Prepare for professional integration at the end of studies;
- Develop entrepreneurial skills in students;
- To raise awareness and familiarize students with the opportunities, challenges, procedures, characteristics, attitudes and skills that entrepreneurship requires;
- To prepare students so that they can, one day or another, start their own business or, at least, better understand their work in an SME.

Recommended prior knowledge:

No special knowledge, except proficiency in 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. To be made aware of entrepreneurship by presenting an overview of management knowledge useful for the creation of activities.

Material content:

Chapter 1 – Operational Readiness for Employment: **(2 weeks)**

Writing the cover letter and drawing up the CV, Job interview, ..., Documentary research on the professions in the sector, Conducting interviews with professionals in the field and Simulation of job interviews.

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

Entrepreneurship, Companies around you, Entrepreneurial motivation, Knowing how to set goals, Knowing how to take risks

Chapter 3 - The profile of an entrepreneur and the job of an 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 – Starting and Running a Business: **(3 weeks)**

Choosing a suitable market, Choosing the location of your business, The legal forms of the business, Seeking help and financing to start a business, Recruiting staff, Choosing your suppliers

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

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

Evaluation method: Exam: 100%

References:

- FayolleAlain, 2017. Entrepreneurship theories and practices, applications to learn to undertake. Dunod, 3rd ed.

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

- PlaneJean-Michel, 2016, Management of Organizations: Theories, Concepts, Performances. Dunod, 4th ed.

- LégerJarniou, Catherine, 2017, Building your Business Plan. The entrepreneur's ledger. 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, Publisher 2011.

- Lucie Beauchesne, Anne Riberolles, Building Your Professional Project, L'Etudiant 2002.

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

IV- Agreements / Conventions

SAMPLE LETTER OF INTENT

(In case of a bachelor's degree co-sponsored by another academic institution)

(Official paper on the letterhead of the university concerned)

Re: Approval of Co-Sponsorship of the Licence entitled:

Hereby, the university (or academic center) declares that it co-sponsors the above-mentioned license during the entire period of authorization of the license.

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

- Giving its 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:

SAMPLE LETTER OF INTENT

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

(Official paper on company letterhead)

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

Provided at:

The company hereby declares its willingness to show 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:

- To give our point of view in the development and updating of teaching programs,
- Participate in seminars organized for this purpose,
- Participate in defense juries,
- To facilitate as much as possible the reception of interns either in the context of end-of-studies theses or in the context of tutored projects.

The means necessary to carry out the tasks incumbent on us for the achievement of these objectives will be implemented on the material and human levels.

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

SIGNATURE of the legally authorized person:

FUNCTION:

Date:

OFFICIAL CACHET or COMPANY SEAL

V - Opinions and Endorsements of Administrative and Advisory Bodies

License Title: Automatic

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

VI – Opinions and Endorsements of the Regional Conference

VII – Opinion and Visa of the National Domain Pedagogical Committee