People's Democratic Republic of Algeria
Ministry of Higher Education and Scientific Research

TRAINING OFFER

L.M.D.

ACADEMIC LICENSE

NATIONAL PROGRAM

2018 - 2019

Establishment	Faculty / Institute	Department

Domain	Sector	Speciality
Science and Technology	***Process Engineering***	***Process Engineering***

CPNDST University

Table

I – License Identity Sheet

1 - Location of the training:

Faculty (or Institute) :

Department :

References of the authorization decree for the License (attach a copy of the decree)

2- External Partnerships

Other partner institutions:

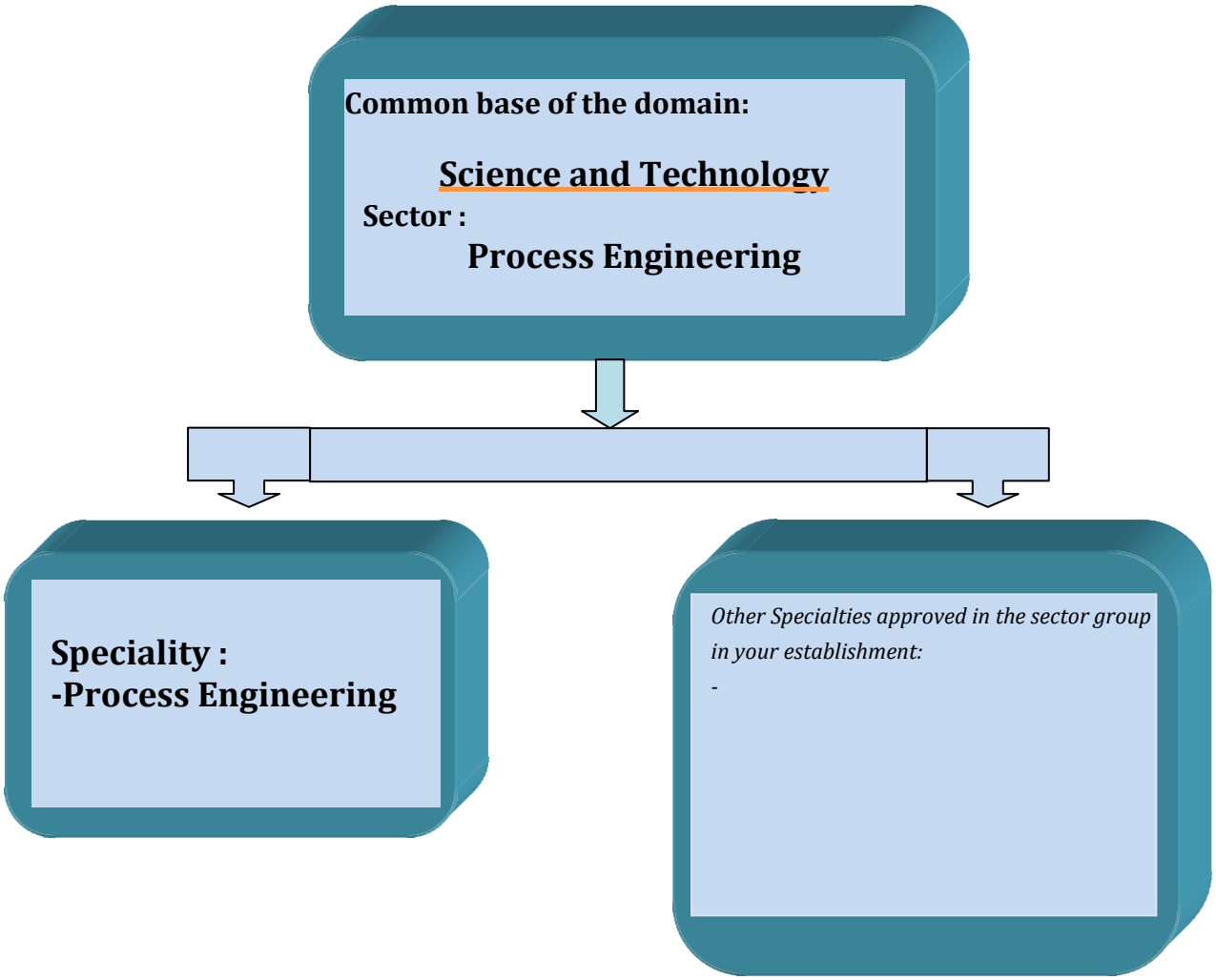
Companies and other socio-economic partners:

International partners :

3 – Context and Objectives of the Program

A – General Organization of the Program: Project Position

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



B - Program Objectives

Process Engineering is an important sector in the field of science and technology (ST domain). Indeed, this sector, which initially developed around fundamental Chemical Engineering, brings together a very wide range of specialties (Chemical Engineering, Environmental Engineering, Materials Engineering, Pharmaceutical Engineering, Electrochemical Engineering, Cryogenics, Energy, Food industry, etc.).

Process Engineering plays an essential role in all industrial processes for transforming matter and energy. To this end, it is essential to train people capable of mastering transformation processes on an industrial scale. This License, whose curriculum contains the fundamental subjects of the sector (physical chemistry, unit operations, transfer phenomena, reactors, etc.) constitutes basic training for all the specialties of Process Engineering.

At the end of this multidisciplinary training, graduates will have acquired basic knowledge, not only in fundamental sciences (Maths, Physics, Chemistry), but also in technology and industrial processes (Reactors, Processes, Transfer Phenomena, Instrumentations, Industrial installations, etc.) which are necessary for understanding process engineering and its various applications.

This training allows the graduate to not only continue their studies and prepare for various specialized masters, but also to quickly integrate into the socio-economic sector.

C – Profiles and skills targeted:

The general nature of the License constitutes basic training in the sector allowing access to masters in the different options (*Chemical Engineering, Environmental Engineering, Pharmaceutical Engineering, Water Treatment, Electrochemical Engineering, Polymer Engineering, Cryogenics etc.* .), these aim to consolidate the basic notions of process engineering.

At the end of the 3rd year License, the graduate has acquired sufficient theoretical and practical knowledge (Knowledge and Know-how) which allows him to assimilate any material transformation process. It is thus capable of establishing assessments of a transformation, sizing and controlling equipment and carrying out measurements in a production and processing chain.

The skills acquired make it possible to integrate different industrial sectors (chemical, pharmaceutical, electrochemical, agri-food industries, materials, cosmetics, water treatment, environmental protection, etc.), and to satisfy the country's need for executives techniques.

D- Regional and National Employability Potential:

Process Engineering deals with the industrialization of chemistry and the processes of transformation and purification of matter. The areas of application follow one another throughout the development of the manufacturing process: development in the laboratory, pilot scale, sizing of the equipment, construction of the unit then its operation..

This process engineering course aims to train versatile executives with knowledge and know-how that allow them to work at all levels of the process. They are intended to occupy positions of Research Manager, Project Manager, Process Technician, etc.

This course targets large companies operating in the fields of processes, chemistry, energy and the environment on a national scale, such as Sonatrach, Sonelgaz, ADE, cement factories, Saidal, etc. At the regional level, there is also a strong potential for opportunities in the fabric of SMEs-SMIs with activities of design offices, expertise firms, material transformation and treatment.

With the course offered as part of this degree, graduates are able to integrate different socio-economic sectors:

- ✓ Technical education in secondary education;
- ✓ Research laboratories;
- ✓ Public organizations;
- ✓ Design offices;
- ✓ The industrial sector.

For this last sector, these graduates constitute the backbone of management in the production units (Chemical Industries, Petrochemicals, Refining, Cement, Water Treatment, Medicine manufacturing technology, Agri-food, etc.)

E - Bridges to Other Specializations:

Common semesters 1 and 2	
Sector	**Spécialités**
Aeronautics	Aeronautics
Civil engineering	Civil engineering
Climate engineering	Climate engineering
Maritime genius	Naval Propulsion and Hydrodynamics
	Naval construction and architecture
Mechanical Engineering	Energy
	Mechanical construction
	Materials Engineering
Hydraulic	Hydraulic
Transportation Engineering	Transportation Engineering
Metallurgy	Metallurgy
Precision optics and mechanics	Optics and photonics
	Precision engineering
Public works	Public works
Automatic	Automatic
Electromechanics	Electromechanics
	Industrial maintenance
Electronic	Electronic
Electrical engineering	Electrical engineering
Biomedical engineering	Biomedical engineering
Industrial Engineering	Industrial Engineering
Telecommunication	Telecommunication
Process Engineering	Process Engineering
Mining engineering	Mining
	Valorization of mineral resources
Hydrocarbons	Hydrocarbons
Industrial hygiene and safety	Industrial hygiene and safety
Petrochemical industries	Petrochemical industries

Table of sectors and specialties in the Science and Technology field

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

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

Group of sectors C	Common semester 3
Sector	**Specialties**
Process Engineering	Process Engineering
Mining engineering	Mining
	Valorization of mineral resources
Hydrocarbons	Hydrocarbons
Industrial hygiene and safety	Industrial hygiene and safety
Petrochemical industries	Petrochemical industries

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

This degree offers multidisciplinary and transversal teaching programs:

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

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

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

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

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

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

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

F - Expected Performance Indicators of the Program :

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

The evaluation methods can be implemented through surveys, field monitoring of students in training and surveys of recruited graduates as well as their employers. To do this, a report must be established, archived and widely distributed.

1. Evaluation of the course of the training:

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

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

Before the training:

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

During training:

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

After the training:

- ✓ Student success rate per semester in this Degree.
- ✓ Student attrition rate (failures and abandonments).
- ✓ Identification of the causes of student failure.
- ✓ Reorientation alternatives are offered to students in a situation of failure.
- ✓ Rate of students who graduate on time.
- ✓ Rate of students who continue their studies after the License.

2. 2. Evaluation of the course of lessons:

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

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

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

- ✓ Number of effective teaching weeks provided during a semester and what about student absenteeism?
- ✓ Completion rate of teaching programs.
- ✓ Digitization and conservation of end of studies and/or end of cycle memories.
- ✓ Number of TPs carried out as well as the multiplication of the type of TPs per subject (diversity of TPs).
- ✓ Quality of the establishment's documentary collection in relation to the specialty and its accessibility.
- ✓ Support from the socio-economic sector for training (company visit, company internship, seminar courses provided by professionals, etc.).

3. Integration of graduates:

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

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

G- Student Evaluation through Continuous Assessment and Personal Work:

G1- Evaluation by continuous monitoring:

The importance of continuous assessment methods on student training in terms of educational outcomes no longer needs to be demonstrated. In this regard, articles 20, 21 and 22 of decree 712 of November 3, 2011, define and specify the modalities as well as the organization of the continuous evaluation of students according to the training course. The calculation of the continuous assessment averages (supervised work and practical work) is made from a weighting of all the elements which constitute this evaluation. These articles specify that this weighting is left to the discretion of the teaching team.

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

The analysis of the different proposals coming from these establishments showed that, indeed, articles 21 and 22 of decree 712 of November 3, 2011 are not explicit enough and deserve more clarification. These articles could be enriched by taking into account the following points which represent a synthesis of the proposals collected.

1. 1. Proposals relating to subjects with tutorials:

1.1. Preparing for series of exercises:

The teacher responsible for the subject must organize himself by proposing a series of exercises for each chapter of the course. This series must be exhaustive with exercises for understanding the course and standard exercises to be solved in a tutorial session.
These exercises must be prepared by the student before coming to the tutorial. This preparation can be evaluated. The evaluation method is left to the discretion of the teacher responsible for the tutorial.

The exercises not solved in tutorial can be the subject of personal work to be carried out by groups of 3 to 4 students and to be submitted for evaluation (deadline: 1 week).

1.2. Written questions:

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

1.3. Student participation in tutorials:

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

1.4. Student Attendance:

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

2. Case of methodological units (Practical work):

In the same way as the tutorials, the practical work must be prepared by the student. A control test of this preparation must be organized by the teacher before each manipulation (in the form of short comprehension questions, multiple choice questions, manipulation diagram, etc.). A report (per working group) must be given at the end of the practical work session.

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

3. About cross-curricular subjects and discoveries that do not have a tutorial or practical work:

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

However, the teacher in charge of this subject can, if he wishes, let the students know that he can possibly evaluate them (ongoing) by offering them to prepare presentations, to make reports, to look for additional information. of the course, use free software, ask students to watch at home a popular science film related to the subject (after having given them either the film on electronic media or having indicated to them the internet link to this film) and ask them to then submit a written report or make an oral presentation of the summary of this film, etc. The improvement of these activities is left to the discretion of the teacher and the training team 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 case where the number of students in this subject is reasonable (20 to 30 students), which may be the case for many masters, the person responsible for the subject may consider continuous evaluations of the student like what is done in subjects with tutorials. The only obligation to respect is that students should be informed of this procedure and validated during the first Teaching Council.

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

4. 4. Harmonization of continuous monitoring:

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

Note that these assessments are not intended to “trap” students by imposing very difficult continuous assessments on them. On the contrary, it is a question of “honestly” evaluating the degree of assimilation of the different skills and knowledge taught to the student in complete objectivity. In the same spirit, we would benefit from promoting the contractualization of learning evaluation by specifying, for example, the success criteria and good practices which would result in correct and precise answers to the questions.

Thus, the evaluation would mainly focus on the acquired knowledge which was the subject of training by giving exercises linked to what was prepared in tutorial without forgetting, however, to evaluate the students' ability to mobilize their skills in more complex situations.

4-1 Tutorials:

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

4.2 Practical work:

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

G2- Student's personal work:

The student's personal work is part of the spirit of the LMD. A very substantial amount of weekly time has been reserved for him: approximately 50% of the total training time (see the "Overall training summary" table in this training offer).
A survey carried out by the CPND-ST among training teams across all university establishments indicated that the time relating to the student's personal work could be judiciously exploited, under good supervision of the teacher, in a manner rational and in different forms. The tasks that would then be accomplished by the volunteer students would be evaluated and counted (as a bonus) in their overall continuous assessment grade. The rate of this bonus is left to the free will of the teaching teams.

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

1. *Homework*:

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

2. Mini course project:

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

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

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

Visits, educational outings, discovery and/or immersion courses are opportunities for students likely to enable them to better understand the reality of the world of work and subsequently help them achieve better professional integration.
Administrative managers as well as teachers must encourage, as much as possible, this very important aspect of training and ensure the organization of educational visits and outings throughout the training course.
They must also help/encourage students to prospect in economic institutions with the aim of finding (in L3 and M1) discovery and/or immersion internships of one to two weeks in the industrial environment during the winter and spring holidays.
In this context, teachers must ensure that students take notes during these outings and require reports (reports of a few pages). This activity can be evaluated, graded and recorded as a bonus for the student who completes it. We can offer students templates to help them present their internship

4. Participation in scientific events:

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

5. Use of New Information and Communication Technologies:

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

Conclusion :

The autonomy of the student, considered as a lever for success, is largely based on the personal work that they are required to do, by appropriating the resources and tools made available to them. All this must, of course, be supervised and formalized within the framework of educational monitoring and support which must be provided jointly by the university teacher and the administrative manager throughout the training course.
This autonomy will allow them to build their professional identity according to their aspirations, their abilities and their acquired knowledge or to build their academic career in the pursuit of higher studies.

4 - Available Human Resources:

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

Number of students:

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

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

Visa from the department

Visa from the faculty or institute

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

Nom et Prénom	Home establishment	Graduation diploma	Specialty diploma (Magister,doctorate)	Grade	Subjects to teach	Registration

Department visa **Faculty or institute visa**

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

Grade	Internal Workforce	External Workforce	Total
Professors			
Conference professors (A)			
Conference professors (B)			
Master Assistant (A)			
Master Assistant (B)			
Other (*)			
Total			

(*)Technical and support staff

5 - Specialized Material Resources

A- Pedagogical Laboratories and Equipment:

Sheet of existing educational equipment for the practical work of the planned training (1 sheet per laboratory)

Laboratory title:

Student capacity:

N°	Equipment designation	Nomber	Comments

B- Internship Sites and Company Training:(see agreements/conventions section)

Training place	Number of students	Training period

C- Documentation Available at the Establishment Specific to the Proposed Program (Required Field):

D- Spaces for Personal Work and ICT (Information and Communication Technology) Available at the Department, Institute, and Faculty Levels:

II – Semester Organization Sheets for Specialty Courses

Semester 1

Teaching Unit	Materials	Credits	Coefficient	Weekly hourly volume			Semiannual Hourly Volume (15 weeks)	Additional work in Consultation (15 weeks)	Evaluation method	
	Titled			Courses	Tutor-ials	Practi-cal work			Continuous control	Exam
Fundamental TU Code : FTU 1.1 Credits : 18 Coefficients : 9	Mathematics 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physical 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Structure of matter	6	3	3h00	1h30		67h30	82h30	40%	60%
Methodological TU Code : MTU 1.1 Credits : 9 Coefficients : 5	Physics lab 1	2	1			1h30	22h30	27h30	100%	
	Chemistry lab 1	2	1			1h30	22h30	27h30	100%	
	Computer science 1	4	2	1h30		1h30	45h00	55h00	40%	60%
	Writing methodology	1	1	1h00			15h00	10h00		100%
Discovery TU Code : DTU 1.1 Credits : 1 Coefficients : 1	Professions in science and technology 1	1	1	1h30			22h30	02h30		100%
Transverse TU Code : TTU 1.1 Credits : 2 Coefficients : 2	Foreign language 1 (French and/or English)	2	2	3h00			45h00	05h00		100 %
Total semester1		**30**	**17**	**16h00**	**4h30**	**4h30**	**375h00**	**375h00**		

Semester 2

Teaching Unit	Materials	Credits	Coefficient	Weekly hourly volume			Semiannual Hourly Volume (15 weeks)	Additional work in Consultation (15 weeks)	Evaluation method	
	Titled			Courses	Tutor-ials	Practi-cal work			Continuous control	Exam
Fundamental TU Code : FTU 1.2 Credits : 18 Coefficients : 9	Mathematics 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physical 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Thermodynamics	6	3	3h00	1h30		67h30	82h30	40%	60%
Methodological TU Code : MTU 1.2 Credits : 9 Coefficients : 5	Physics lab 2	2	1			1h30	22h30	27h30	100%	
	Chemistry lab 2	2	1			1h30	22h30	27h30	100%	
	Computer science 2	4	2	1h30		1h30	45h00	55h00	40%	60%
	Presentation methodology	1	1	1h00			15h00	10h00		100%
Discovery TU Code : DTU 1.2 Credits : 1 Coefficients : 1	Professions in science and technology 2	1	1	1h30			22h30	02h30		100%
Transverse TU Code : TTU 1.2 Credits : 2 Coefficients : 2	Foreign language 2 (French and/or English)	2	2	3h00			45h00	05h00		100 %
Total semester 2		**30**	**17**	**16h00**	**4h30**	**4h30**	**375h00**	**375h00**		

Semester 3

Teaching Unit	Materials Titled	Credits	Coefficient	Weekly hourly volume			Semiannual Hourly Volume (15 weeks)	Additional work in Consultation (15 weeks)	Evaluation method	
				Courses	Tutor-ials	Practi-cal work			Continuous control	Exam
Fundamental TU Code : FTU 2.1.1 Credits : 10 Coefficients : 5	Mathematics 3	6	3	3h00	1h30		67h30	82h30	40%	60%
	Waves and vibrations	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Code : FTU 2.1.2 Credits : 8 Coefficients : 4	Fluid mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Mineral Chemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological TU Code : MTU 2.1 Credits : 9 Coefficients : 5	Probability and statistics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Computer science 3	2	1			1h30	22h30	27h30	100%	
	Drawing technique	2	1			1h30	22h30	27h30	100%	
	Waves and vibrations Lab	1	1			1h00	15h00	10h00	100%	
Discovery TU Code : DTU 2.1 Credits : 2 Coefficients : 2	Industrial HSE installations	1	1	1h30			22h30	02h30		100%
	Regulations and standards	1	1	1h30			22h30	02h30		100%
Transverse TU Code : TTU 2.1 Credits : 1 Coefficients : 1	English technique	1	1	1h30			22h30	02h30		100%
Total semester 3		**30**	**17**	**13h30**	**7h30**	**4h00**	**375h00**	**375h00**		

Semester 4

Teaching Unit	Materials Titled	Credits	Coefficient	Weekly hourly volume			Semiannual Hourly Volume (15 weeks)	Additional work in Consultation (15 weeks)	Evaluation method	
				Courses	**Tutor-ials**	**Practi-cal work**			**Continuous control**	**Exam**
Fundamental TU Code : FTU Code : UEF 2.2.1 Credits : 8 Coefficients : 5	Chemistry of solutions	4	2	1h30	1h30		45h00	55h00	40%	60%
	Organic chemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Code : FTU 2.2.2 Credits : 8 Coefficients : 4	Chemical thermodynamics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Numerical methods	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Code : FTU 2.2.3 Credits : 2 Coefficients : 1	Chemical kinetics	2	1	1h30			22h30	27h30		100%
Methodological TU Code : MTU 2.2 Credits : 9 Coefficients : 5	Chemistry of solutions Lab	2	1			1h30	22h30	27h30	100%	
	Organic chemistry Lab	1	1			1h00	15h00	10h00	100%	
	Fluid mechanics Lab	2	1			1h30	22h30	27h30	100%	
	Numerical methods Lab	2	1			1h30	22h30	27h30	100%	
	Chemical kinetics Lab	2	1			1h30	22h30	27h30	100%	
Discovery TU Code : DTU 2.2 Credits : 2 Coefficients : 2	Introduction to Refining and Petrochemicals	1	1	1h30			22h30	02h30		100%
	Notions of transfer phenomena	1	1	1h30			22h30	02h30		100%
Transverse TU Code : TTU 2.2 Credits : 1 Coefficients : 1	Expression and communication techniques	1	1	1h30			22h30	02h30		100%
Total semester 4		**30**	**17**	**12h00**	**6h00**	**7h00**	**375h00**	**375h00**		

Semestrer5

Teaching Unit	Materials	Credits	Coefficient	Weekly hourly volume			Semiannual Hourly Volume (15 weeks)	Additional work in Consultation (15 weeks)	Evaluation method	
	Titled			Courses	Tutor-ials	Practi-cal work			Continuous control	Exam
Fundamental TU Code : FTU **3.1.1** **Credits : 10** **Coefficients : 5**	Heat transfer	4	2	1h30	1h30		45h00	55h00	40%	60%
	Material Transfer	4	2	1h30	1h30		45h00	55h00	40%	60%
	Quantity Transfer of Movement	2	1	1h30			22h30	27h30		100%
Fundamental TU Code : FTU **3.1.2** **Credits : 8** **Coefficients : 4**	Electrochemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
	Instrumentation - sensors	2	1	1h30			22h30	27h30		100%
	Kinetics and homogeneous catalysis	2	1	1h30			22h30	27h30		100%
Methodological TU Code : MTU 3.1 Credits : 9 Coefficients : 5	Analysis techniques	4	2	1h30		1h30	45h00	55h00	40%	60%
	Chemistry Physics 1 and Chemical Engineering1 Lab	2	1			1h30	22h30	27h30	100%	
	Macroscopic assessments	3	2	1h30	1h00		37h30	37h30	40%	60%
Discovery TU Code : DTU 3.1 Credits : 2 Coefficients : 2	pharmaceutical processes	1	1	1h30			22h30	02h30		100%
	Agro-food processes	1	1	1h30			22h30	02h30		100%
Transverse TU Code : TTU **3.1** **Credits : 1** **Coefficients : 1**	Pollution: Air, water, soil	1	1	1h30			22h30	02h30		100%
Total semester 5		**30**	**17**	**16h30**	**5h30**	**3h00**	**375h00**	**375h00**		

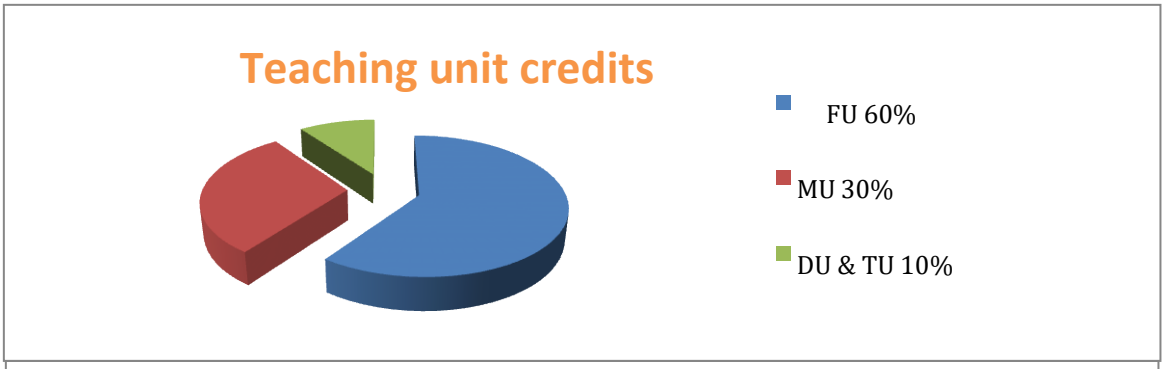
Semester 6

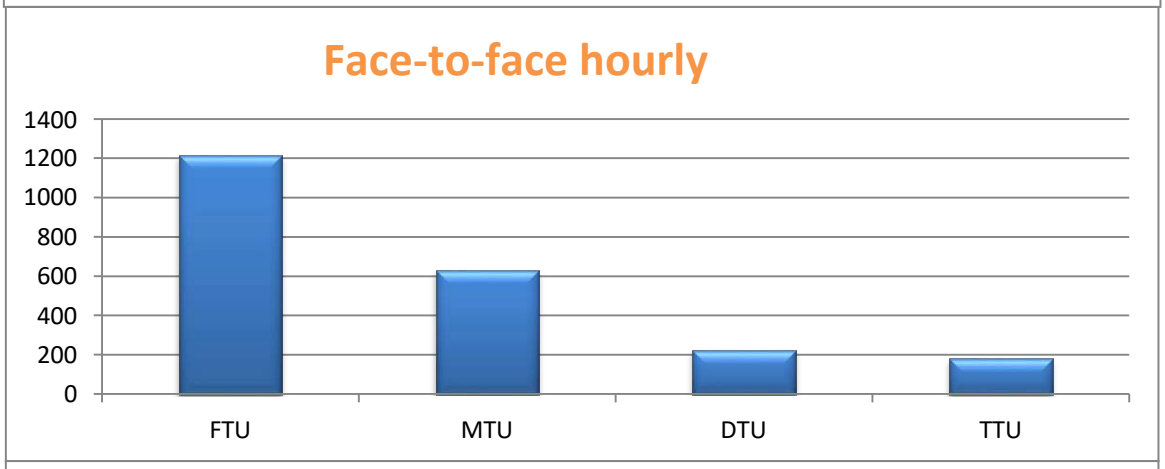
Teaching Unit	Materials	Credits	Coefficient	Weekly hourly volume			Semiannual Hourly Volume (15 weeks)	Additional work in Consultation (15 weeks)	Evaluation method	
	Titled			Courses	Tutor-ials	Practi-cal work			Continuous control	Exam
Fundamental TU Code : FTU 3.2.1 Credits : 10 Coefficients : 5	Unitary operations	6	3	3h00	1h30		67h30	82h30	40%	60%
	Thermodynamics of equilibria	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Code : FTU 3.2.2 Credits : 8 Coefficients : 4	Homogeneous reactors	4	2	1h30	1h30		45h00	55h00	40%	60%
	Surface phenomena and heterogeneous catalysis	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological TU Code : MTU 3.2 Credits : 9 Coefficients : 5	End of Cycle Project	4	2			3h00	45h00	55h00	100%	
	Process simulators	3	2	1h30		1h00	37h30	37h30	40%	60%
	Chemistry Physics2 and Chemical Engineering 2 Lab	2	1			1h30	22h30	27h30	100%	
Discovery TU Code : DTU 3.2 Credits : 2 Coefficients : 2	Cryogenic processes	1	1	1h30			22h30	02h30		100%
	Corrosion	1	1	1h30			22h30	02h30		100%
Transverse TU Code : TTU 3.2 Credits : 1 Coefficients : 1	Professional project and business management	1	1	1h30			22h30	02h30		100%
Total semester 6		**30**	**17**	**13h30**	**6h00**	**5h30**	**375h00**	**375h00**		

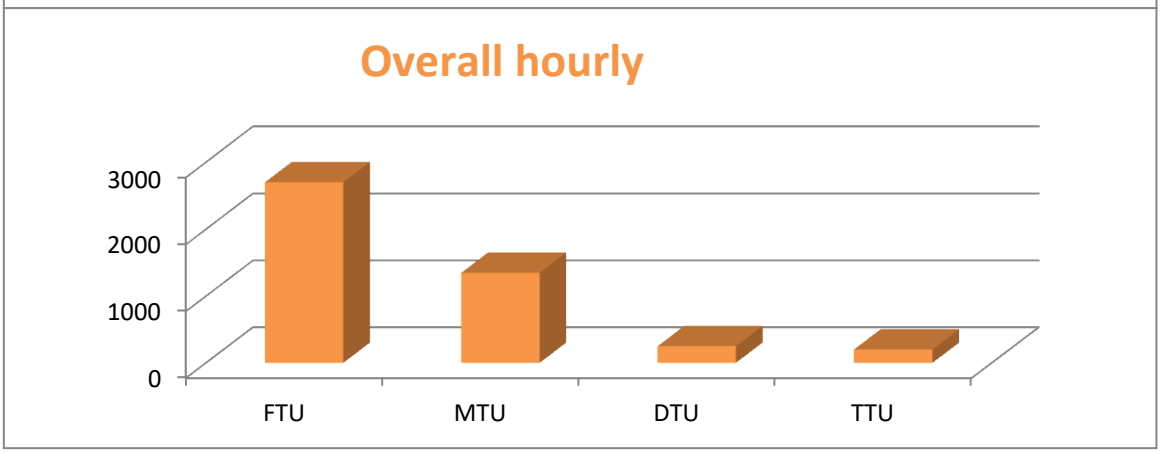
The evaluation methods presented in these tables are given for information purposes only; the establishment's training team may suggest other weightings.

Overall training summary:

TU / HV	FTU	MTU	DTU	TTU	Total
Course	742h30	165h00	225h00	180h00	1312h30
Tutor-ials	472h30	45h00	---	---	517h30
Practi-cal work	---	420h00	---	---	420h00
Personal work	1485h00	720h00	25h00	20h00	2250h00
other (explain, list,)	---	---	---	---	---
Total	2700h00	1350h00	250h00	200h00	4500h00
Credits	108	54	10	8	180
% in credits for each EU	60 %	30 %	10 %		100 %







III - Detailed Program by Subject for Semesters S1 to S6

CPNDST University

Semester: 1
Teaching unit: FTU 1.1
Material 1: Mathematics 1
SHV: 67h30 (Course: 3h00, Tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

Basic notions of mathematics for Terminale classes (sets, functions, equations, etc.).

Material content:

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

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

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

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

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

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

Evaluation method:

Continuous control 40%; Exam:60%.

Bibliographic references:

1- K. Allab, Eléments d'analyse, Fonction d'une variable réelle, 1re& 2e années d'université, Office des Publications universitaires.
2- J. Rivaud, Algèbre : Classes préparatoires et Université Tome 1, Exercices avec solutions, Vuibert.
3- N. Faddeev, I. Sominski, Recueil d'exercices d'algèbre supérieure, Edition de Moscou
4- M. Balabne, M. Duflo, M. Frish, D. Guegan, Géométrie – 2e année du 1er cycle classes préparatoires, Vuibert Université.
5- B. Calvo, J. Doyen, A. Calvo, F. Boshet, Exercices d'algèbre, 1er cycle scientifique préparation aux grandes écoles 2e année, 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- Calcul intégral et séries, Dunod.
9- J. Quinet, Cours élémentaire de mathématiques supérieures 4- Equations différentielles, Dunod.

Semester: 1
Teaching Unit: FTU1.1
Material 2: Physical 1
SHV: 67h30 (Course: 3h00, Tutorials: 1h30)
Crdits: 6
Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

Concepts of mathematics and physics.

Material content:

Math reminders (2 Weeks)

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

Chapter 1. Cinematics (5 Weeks)

1- Position vector in coordinate systems (Cartesian, cylindrical, spherical, curvilinear) - law of motion - Trajectory. 2- Speed and acceleration in coordinate systems.3- Applications: Movement of the material point in different coordinate systems.4- Relative movement.

Chapter 2. Dynamics: (4 Weeks)

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

Chapter 3. Work and energy (4 Weeks)

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

Evaluation method:

Continuous control 40%; Exam: 60%.

Bibliographic references:

1. A.Gibaud, M. Henry ; Cours de physique - Mécanique du point - Cours et exercices corrigés; 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: FTU1.1
Material 3: Structure of matter
SHV: 67h30 (Course: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

Basic notions of mathematics and general chemistry.

Material content:

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

Chapter 2: Main constituents of matter (3 Weeks)
Introduction: Faraday's experiment: relationship between matter and electricity, Highlighting the constituents of matter and therefore of the atom and some physical properties (mass and charge), Rutherford's planetary model, Presentation and characteristics of the atom (Symbol, atomic number Z, mass number A, number of proton, neutrons and electron), Isotopia and relative abundance of the different isotopes, Separation of isotopes and determination of the atomic mass and the average mass of an atom: Mass spectrometry: Bainbridge spectrograph, Binding and cohesion energy of nuclei, Stability of nuclei.

Chapter 3: Radioactivity – Nuclear reactions (2Weeks)
Natural radioactivity (α, β and γ radiation), Artificial radioactivity and nuclear reactions, Kinetics of radioactive decay, Applications of radioactivity.

Chapter 4: Electronic structure of the atom (2 weeks)
Wave-particle duality, Interaction between light and matter, Bohr's atomic model: hydrogen atom, The hydrogen atom in wave mechanics, Polyelectronic atoms in mechanics undulatory.

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

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

Evaluation method:

Continuous control 40%; Examination: 60%

Bibliographic references

1. Ouahes, Devallez, Chimie Générale, OPU.
2. S.S. Zumdhal & coll., Chimie Générale, De Boeck Université.
3. Y. Jean, Structure électronique des molécules : 1 de l'atome aux molécules simples, 3e édition, Dunod, 2003.
4. F. Vassaux, La chimie en IUT et BTS.
5. A. Casalot & A. Durupthy, Chimie inorganique cours 2ème cycle, 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: MTU 1.1
Material 1: Physics lab 1
SHV: 22h30 (Practical work: 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

Concepts of mathematics and physics.

Material content:

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

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

Evaluation method:

Continuous control: 100%.

Semester: 1
Teaching Unit: MTU 1.1
Material 2: Chemistry lab 1
SHV: 22h30 (Practical work: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Basic concepts of Chemistry.

Material content:

1. Safety in the laboratory

2. Preparation of solutions

3. Notions on uncertainty calculations applied to chemistry.

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

5. Acid-base dosage by conductivity meter.

5. Redox assay

6. Determination of water hardness

7. Determination of ions in water: dosage of chloride ions using the Mohr method.

Evaluation method:

Continuous control: 100%

Semester: 1
Teaching Unit: MTU1.1
Material 3: Computer science 1
SHV: 45h00 (Course: 1h30, Practical work:: 1h30)
Credits: 4
Coefficient: 2

Objective and recommendations:

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

Recommended prior knowledge
Basic notions of web technology.

Material content:
Part 1. Introduction to computers (5 Weeks)
1- Definition of IT
2- Evolution of computing and computers
3- Information coding systems
4- Operating principle of a computer
5- Hardware part of a computer
6- System part
Basic systems (operating systems (Windows, Linux, Mac OS, etc.) Programming languages, application software

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

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

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

Bibliographic references

1- John Paul Mueller et Luca Massaron, Les algorithmes pour les Nuls grand format, 2017.
2- Charles E. Leiserson, Clifford Stein et Thomas H. Cormen, Algorithmique: cours avec 957 exercices et 158 problèmes, 2017.
3- Thomas H. Cormen, Algorithmes: Notions de base, 2013.

Semester: 1
Teaching Unit: MTU1.1
Material 4: Writing methodology
SHV: 15h00 (Course: 1h00)
Credits: 1
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Basic French. Basic principle of writing a document.

Material content:

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

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

Chapter 3 Writing Techniques and Procedures (3 Weeks)
- Basic principle of writing - Punctuation, Syntax, Sentences
- Sentence length
- Division into paragraphs
- The use of a neutral style and writing in the third person
- Readability
- Objectivity
- Intellectual rigor and Plagiarism

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

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

Evaluation method:

Exam: 100%.

Bibliographic references

1. J.-L. Lebrun, Guide pratique de rédaction scientifique, EDP Sciences, 2007.
2. M. Fayet, Réussir ses comptes rendus, 3e édition, Eyrolles, 2009.
3. M. Kalika, Mémoire de master - Piloter un mémoire, Rédiger un rapport, Préparer une soutenance, Dunod, 2016.
4. M. Greuter, Réussir son mémoire et son rapport de stage, l'Etudiant, 2014
5. F. Cartier, Communication écrite et orale, Edition GEP- Groupe Eyrolles, 2012.
6. M. Fayet, Méthodes de communication écrite et orale, 3e édition, 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 Professionnal English, Springer, 2014.

Semester: 1
Teaching Unit: DTU 1.1
Matetial 1: Professions in science and technology 1
SHV: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

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

Recommended prior knowledge
None.

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

2. Electronics, Telecommunications, Biomedical Engineering, Electrotechnics, Electromechanics, Optics & Precision Mechanics sectors: (2 weeks)
- Definitions, fields of application (Home automation, embedded applications for automobiles, Video surveillance, Mobile telephony, Optical fiber, Advanced scientific instrumentation, Imaging and medical instrumentation, Giant mirrors, Contact lenses, Transport and distribution of electrical energy, Electricity production plants, Energy efficiency, Maintenance of industrial equipment, Elevators, Wind turbines, etc.
- Role of the specialist in these areas.

3. Automation and Industrial Engineering sectors: (1 week)
- Definitions, areas of application (automated industrial chains, Numerical Control machine tools, Robotics, Inventory management, Goods traffic management, Quality, - Role of the specialist in these areas.

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

5. Sustainable development (SD): (4 weeks)
Definitions, Global issues (climate change, Demographic transitions, Depletion of resources (oil, gas, coal, etc.), Depletion of biodiversity, etc.), Diagram of SD (Sustainable = Viable + Livable + Equitable), SD actors (governments, citizens, socio-economic sector, international organizations, etc.), Global nature of SD challenges

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

Student's personal work for this subject:

The teacher responsible for this subject can let his students know that he can always evaluate them by offering to prepare job descriptions. Ask students to watch at home a popular science film related to the chosen profession (after having given them either the film on electronic media or having indicated to them the internet link to this film) and ask them to then submit a written report or to make an oral presentation of the summary of this film, … etc. The improvement of these activities is left to the discretion of the teacher and the training team 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:

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

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

Evaluation method:

100% Exam

Bibliographic references:

1- Quels métiers pour demain ? Éditeur : ONISEP, 2016, Collection : Les Dossiers.
2- J. Douënel et I. Sédès, Choisir un métier selon son profil, Editions d'Organisation, Collection : Emploi & carrière, 2010.
3- V. Bertereau et E. Ratière, Pour quel métier êtes-vous fait ? Editeur : L'Étudiant, 6e édition, Collection : Métiers, 2015.
4- Le grand livre des métiers, Éditeur : L'Étudiant, Collection : Métiers, 2017.
5- Les métiers de l'industrie aéronautique et spatiale, Collection : Parcours, Edition : ONISEP, 2017.
6- Les métiers de l'électronique et de la robotique, Collection : Parcours, Edition : ONISEP, 2015.
7- Les métiers de l'environnement et du développement durable, Collection : Parcours, Edition : ONISEP, 2015.
8- Les métiers du bâtiment et des travaux publics, Collection : Parcours, Edition : ONISEP, 2016.
9- Les métiers du transport et de la logistique, Collection : Parcours, Edition : ONISEP, 2016.
10- Les métiers de l'énergie, 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- Les métiers de la biologie, Collection : Parcours, Edition : ONISEP, 2016.

Semestre: 1
Teaching Unit: TTU 1.1
Matetial 1: Foreign language French 1
SHV: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Objective of the subject:

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

Recommended prior knowledge

Basic French.

Content of the material:

We offer below a set of themes that deal with fundamental sciences, technologies, economics, social facts, communication, sport, health, etc. The teacher can choose from this list of texts to develop them during the course. Otherwise, he is free to address other themes of his choice. The texts can be borrowed from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular magazines, books, websites, audio and video recordings, etc.
For each text, the teacher helps the student to develop their linguistic skills: listening, comprehension, oral and written expression. In addition, he must use this text to identify the grammatical structures that he will develop during the same class session. We recall here, by way of illustration, a set of grammatical structures which can be developed as examples. Of course, it is not a question of developing them all or in the same way. Some can be recalled and others can be detailed.

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

Evaluation method:
100% Exam

Bibliographic references:

1. M. Badefort, Objectif : 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, Grammaire progressive du Français avec 400 exercices, Niveau avancé, CLE International.
4. Collectif, Besherelles : la Grammaire pour tous, Hatier.
5. Collectif, 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, Presses de l'université du Québec, 2006.
8. J.-L. Lebrun, Guide pratique de la rédaction scientifique, EDP Sciences, 2007.
9. J.M. Robert, Difficultés du Français, Hachette,
10. C. Tisset, Enseigner la langue française à l'école : La Grammaire, L'Orthographe et la Conjugaison, Hachette Education, 2005.
11. J. Bossé-Andrieu, Abrégé des Règles de Grammaire et d'Orthographe, Presses de l'université du Québec, 2001.
12. J.-P. Colin, Le français tout simplement, 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 corrigées, Hachette, 2000.
15. Ch. Descotes et al., L'Exercisier : l'expression française pour le niveau intermédiaire, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, Sur le Vif, Heinle Cengage Learning, 2011.
17. J. Dubois et al., Les indispensables – Orthographe, Larousse, 2009.

Semester: 1
Teaching Unit: TTU 1.1
Matetial 1: Foreign language - English 1
SHV: 22h30 (Course: 1h30)
Credit: 1
Coefficient: 1

Objective:
Develop the reading, writing, listening and speaking abilities of the students.
Recommended prior Knowledge:
Basic English.

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

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

Evaluation mode:
Exam : 100%.

References:

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

10. P. Charles Brown, Norma D. Mullen, English for Computer Science, Oxford University Press, 1989.
11. Graeme Kennedy, Structure and Meaning in English: A Guide for Teachers, Pearson, 2004.
12. Anne M. Hanson, Brain-Friendly Strategies for Developing Student Writing Skills, 2nd Edition, Corwin Press, 2008.
13. Ann Bridges, How to Pass Higher English, Hodder Gibson-Hachette, 2009.
14. Claude Renucci, Anglais : 1000 Mots et expressions de la presse : Vocabulaire et expressions du monde économique, social et politique, Fernand Nathan, 2006.

Semester: 2
Teaching Unit: FTU 1.2
Material 1: Mathematics 2
SHV: 67h30 (Course: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

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

Material content:

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

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

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

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

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

Evaluation method:

Continuous control 40%; Exam: 60%.

Bibliographic references:

1- F. Ayres Jr, Théorie et Applications du Calcul Différentiel et Intégral - 1175 exercices corrigés, McGraw-Hill.
2- F. Ayres Jr, Théorie et Applications des équations différentielles - 560 exercices corrigés, McGraw-Hill.
3- J. Lelong-Ferrand, J.M. Arnaudiès, Cours de Mathématiques - Equations différentielles, Intégrales multiples, Tome 4, Dunod Université.
4- M. Krasnov, Recueil de problèmes sur les équations différentielles ordinaires, Edition de Moscou

5- N. Piskounov, Calcul différentiel et intégral, Tome 1, Edition de Moscou
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, Algèbre : Classes préparatoires et Université Tome 1, Exercices avec solutions, Vuibert.
11- N. Faddeev, I. Sominski, Recueil d'exercices d'algèbre supérieure, Edition de Moscou.

Semester: 2
Teaching Unit: FTU 1.2
Material 2: Physical 2
SHV: 67h30 (Course: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

Mathematics 1, Physics 1.

Material content:

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-Conductors in equilibrium.7-Electrostatic pressure.8-Capacitance of a conductor and a capacitor.

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

Chapter III. Electromagnetism: (4 Weeks)
1- Magnetic field: Definition of a magnetic field, Biot and Savart's law, Ampère's theorem, Calculation of magnetic fields created by permanent currents.
2- Induction phenomena: Induction phenomena (circuit in a variable magnetic field and moving circuit in a permanent magnetic field), Lorentz force, Laplace force, Faraday's law, Lenz's law, Application to coupled circuits.

Evaluation method:

Continuous control 40%; Exam: 60%.

Bibliographic references:

1. J.-P. Perez, R. Carles, R. Fleckinger ; Electromagnétisme Fondements et Applications, Ed. Dunod, 2011.
2. H. Djelouah ; Electromagnétisme ; 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: FTU 1.2
Material 3: Thermodynamics
SHV: 67h30 (Course: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives

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

Recommended prior knowledge

Basic mathematics.

Material content:

Chapter 1: General information on thermodynamics (3 Weeks)

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

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

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

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

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

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

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

Chapter 5:The 3rd Principle and absolute entropy (1 week)

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

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

Evaluation method:

Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. C. Coulon, S. LeBoiteux S. et P. Segonds,Thermodynamique Physique - Cours et exercices avec solutions, Edition Dunod.
2. H.B. Callen, Thermodynamics, Cours, Edition John Wiley and Sons, 1960

3. R. Clerac, C. Coulon, P. Goyer, S. LeBoiteux & C. Rivenc,Thermodynamics, Cours et travaux dirigés 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: MTU 1.2
Material 1: Physics lab 2
SHV: 45h00 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Mathematics 1, Physics 1.

Material content:

5 manipulations at least (3 hours / 15 days)

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

Evaluation method:

Continuous control: 100%

Semester: 2
Teaching Unit: MTU 1.2
Material 2: Chemistry lab 2
SHV 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Thermodynamics.

Material content:

1. Ideal gas laws.
2. Water value of the calorimeter.
3. Specific heat: specific heat of liquid and solid bodies.
4. Latent heat: Latent heat of melting ice
5. Heat of reaction: Determination of the energy released by a chemical reaction (HCl/NaOH)
6. Hess's law
7. Vapor pressure of a solution.

Evaluation method:

Continuous control: 100%

Semester: 2
Teaching Unit: MTU1.2
Material 3: Computer science 2
SHV: 45h00 (Course: 1h30, PW: 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: Indicated 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: Concepts of global variables and local variables, simple procedure, procedure with arguments
Chapter 3: Recordings and files (5 Weeks)
1- Heterogeneous data structure
2- Structure of a record (concept of fields) 3- Handling of record structures
4- Concept of file
5- File access modes
6- Reading and writing to a file
Computer science lab 2:
Plan a certain number of practical exercises to concretize the programming techniques seen during the course.
- Practical work on the application of programming techniques seen in class.

Evaluation method:

Continuous control: 40% ; Exam: 60%.

Bibliographic references:

1- Les algorithmes pour les Nuls grand format Livre de John Paul Mueller (Informatiker, USA) et Luca Massaron 2017
2- Algorithmique: cours avec 957 exercices et 158 problèmes Livre de Charles E. Leiserson, Clifford Stein et Thomas H. Cormen 2017
3- Algorithmes: Notions de base Livre de Thomas H. Cormen 2013.

Semester: 2
Teaching Unit: MTU 1.2
Material 4: Presentation methodology
SHV: 15h00 (Course: 1h00)
Credits: 1
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Expression and communication techniques and writing methodology.

Material content:

Chapter 1: The oral presentation (3 Weeks)
Communication. Preparation of an oral presentation. Different types of plans.
Chapter 2: Presentation of an oral presentation (3 Weeks)
Structure of an oral presentation. Presentation of an oral presentation.
Chapter 3: Plagiarism and Intellectual Property (3 Weeks)
1- Plagiarism: Definitions of plagiarism, sanction of plagiarism, how to borrow the work of other authors, quotes, illustrations, how to be sure to avoid plagiarism?
2- Writing a bibliography: Definition, objectives, how to present a bibliography, writing the bibliography
Chapter 4: Presenting written work (6 Weeks)
- Present written work. Applications: presentation of an oral presentation.

Evaluation method:

Exam: 100%.

Bibliographic references:

1. M. Fayet, Méthodes de communication écrite et orale, 3e édition, Dunod, 2008.
2. M. Kalika, Mémoire de master – Piloter un mémoire, Rédiger un rapport, Préparer unesoutenance, Dunod, 2016.
3. M. Greuter, Réussir son mémoire et son rapport de stage, l'Etudiant, 2014
4. B. Grange, Réussir une présentation. Préparer des slides percutants et bien communiquer enpublic. Eyrolles, 2009.
5. H. Biju-Duval, C. Delhay, Tous orateurs, Eyrolles, 2011.
6. C. Eberhardt, Travaux pratiques avec PowerPoint. Créer et mettre en page des diapositives,Dunod, 2014.
7. F. Cartier, Communication écrite et orale, Edition GEP- Groupe Eyrolles, 2012.
8. L. Levasseur, 50 exercices pour prendre la parole en public, Eyrolles, 2009.
9. S. Goodlad, Speaking technically – A Handbook for Scientists, Engineers, and Physicians on Howto Improve Technical Presentations, Imperial College Press, 2000.
10. M. Markel, Technical communication, eleventh edition, Bedford/St Martin's, 2015.

Semester: 2
Teaching Unit: DTU 1.2
Material 1: Professions in science and technology
VHS: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

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

Recommended prior knowledge
None.

Content of the material:

1. Industrial Hygiene and Safety (HSI) and Mining Engineering sectors: (2 weeks)
- Definitions and areas of application (Security of goods and people, Environmental problems, Exploration and exploitation of mineral resources, etc.)
- Role of the specialist in these areas.

2. Climate Engineering and Transport Engineering courses: (2 weeks)
- Definitions, areas of application (Air conditioning, Smart buildings, Transport security, Traffic management and road, air, naval transport, etc.)
- Role of the specialist in these areas.

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

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

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

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

7. Sustainable development and business: (3 weeks)
Definition of the company as an economic entity (concepts of profit, costs, performance) and social (concept of corporate social responsibility), Impact of economic activities on the environment (examples), Issues/benefits of SD for the company, Means of engagement in a SD approach (e.g. ISO 14001 certification, labeling (e.g. energy labeling, Ecolabel, Organic/AB Label, FSC Label, etc.), strategic SD plan, Global Reporting Initiative (GRI)…), Global rankings of the most sustainable companies (Dow Jones Sustainable

Index, Global 100, ….), Case studies of successful/eco-responsible companies in ST sectors (e.g. SIEMENS, Cisco, Henkel AG& Co, TOTAL, Peugeot, Eni SPA …).

Student's personal work for this subject:
- **Work in groups/pairs**: Reading articles on sustainable development and/or reports from successful and sustainable companies and developing summaries of the main actions undertaken in the field of SD.

Examples of documents for reading and synthesis:
- Case of ONA and ENIEM: Kadri, Mouloud, 2009, Sustainable development, business and ISO 14001 certification, Market and organizations vol. 1 (No. 8), p. 201- 215 (free online access : http://www.cairn.info/revue-marche-et-organizations-2009-1-page-201.htm)

- Mireille Chiroleu-Assouline. Corporate sustainable development strategies. Ideas, The journal of economic and social sciences, CNDP, 2006, p 32-39 (free online access: http://halshs.archives-ouvertes.fr/hal-00306217/document)
- Web page on TOTAL's environmental and societal commitments: https://www.total.com/fr/engagement
- Sustainable mobility innovations from the PSA group: http://www.rapportannuel.groupe-psa.com/rapport-2015/engagements/dessolutions-innovantes-pour-des-transports-durables/

Evaluation method:

100% Exam

Bibliographic references:

1- V. Maymo et G. Murat, La boîte à outils du Développement durable et de la RSE- 53 outils et méthodes, Edition : Dunod, 2017.
2- P. Jacquemot et V. Bedin, Le dictionnaire encyclopédique du développement durable, Edition : Sciences Humaines, 2017.
3- Y. Veyret, J. Jalta et M. Hagnerelle, Développements durables : Tous les enjeux en 12 leçons, Edition : Autrement, 2010.
4- L. Grisel et Ph. Osset, L'Analyse du cycle de vie d'un produit ou d'un service: Applications et mise en pratique, 2eme Edition : AFNOR, 2008.
5- Sh. Shaked, N. Jolliet-Gavin, P. Crettaz, M. Saadé-Sbeih et O. Jolliet, Analyse du cycle de vie: Comprendre et réaliser un écobilan, 3eme Edition : PPUR, 2017.
6- G. Pitron et H. Védrine, La guerre des métaux rares : La face cachée de la transition énergétique et numérique**,** Edition : Liens qui libèrent, 2018.
7- Les métiers de l'environnement et du développement durable, Collection : Parcours, Edition : ONISEP, 2015.

Semester: 2
Teaching Unit: TTU 1.2
Material 1: Foreign language –French 2
SHV: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

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

Recommended prior knowledge:
Basic French.

Material content:
We offer below a set of themes that deal with fundamental sciences, technologies, economics, social facts, communication, sport, health, etc. The teacher can choose from this list of texts to develop them during the course. Otherwise he is free to address other themes of his choice. The texts can be borrowed from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular magazines, books, websites, audio and video recordings, etc.
For each text, the teacher helps the student to develop their linguistic skills: listening, comprehension, oral and written expression. In addition, he must use this text to identify the grammatical structures that he will develop during the same class session. We recall here, by way of illustration, a set of grammatical structures which can be developed as examples. Of course, it is not a question of developing them all or in the same way. Some can be recalled and others can be detailed.

Examples of themes	Grammatical structures
The pharmaceutical industry The food industry The national employment agency ANEM Sustainable development Renewable energies Biotechnology Stem cells Road safety Roadblocks Water – Water resources Avionics Automotive electronics Electronic newspapers Carbon-14 dating Violence in stadiums Drugs: a social scourge Smoking School failure The Algerian War Social networks China, an economic power Superconductivity Cryptocurrency Advertising Autism	The subjunctive. The conditional. The imperative. The past participle. Passive form. Possessive adjectives, Possessive pronouns. Demonstratives, Demonstrative pronouns. The expression of quantity (several, a few, enough, many, more, less, as much, etc.). Numbers and measurements. The pronouns “who, that, where, whose”. Subordinate preposition of time. The cause, the consequence. The goal, the opposition, the condition. Comparisons, superlatives. …

Evaluation method:
100% Exam

Bibliographic references:

1. M. Badefort, Objectif : 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, Grammaire progressive du Français avec 400 exercices, Niveau avancé, CLE International.
4. Collectif, Besherelles : la Grammaire pour tous, Hatier.
5. Collectif, 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, Presses de l'université du Québec, 2006.
8. J.-L. Lebrun, Guide pratique de la rédaction scientifique, EDP Sciences, 2007.
9. J.M. Robert, Difficultés du Français, Hachette,
10. C. Tisset, Enseigner la langue française à l'école : La Grammaire, L'Orthographe et la Conjugaison, Hachette Education, 2005.
11. J. Bossé-Andrieu, Abrégé des Règles de Grammaire et d'Orthographe, Presses de l'université du Québec, 2001.
12. J.-P. Colin, Le français tout simplement, 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 corrigees, Hachette, 2000.
15. Ch. Descotes et al., L'Exercisier : l'expression française pour le niveau intermédiaire, Presses Universitaires de Grenoble, 1993.
16. H. Jaraush, C. Tufts, Sur le Vif, Heinle Cengage Learning, 2011.
17. J. Dubois et al., Les indispensables – Orthographe, Larousse, 2009.

Semester: 2
Teaching Unit: TTU 1.2
Material 1: Foreign language – english 2
SHV: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

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

Recommended prior Knowledge:
Basic English.

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

Examples for some lectures:	Examples of Word Study: Patterns
Radioactivity.	Explanation of Cause
Chain Reaction.	Result
Reactor Cooling System.	Conditions (if), Conditions (Restrictive)
Conductor and Conductivity.	Eventuality
Induction Motors.	Manner
Electrolysis.	When, Once, If, etc. + Past Participle
Liquid Flow and Metering.	It is + Adjective + to
Liquid Pumps.	As
Petroleum.	It is + Adjective or Verb + that…
Road Foundations.	Similarity, Difference
Rigid Pavements.	In Spite of, Although
Piles for Foundations.	Formation of Adjectives
Suspension Bridges.	Phrasal Verbs

Evaluation mode:
Exam : 100%.

References:

1. J. Upjohn, S. Blattes, V. Jans, Minimum Competence in Scientific English, Office des Publications Universitaires, 1994.
2. A.J. Herbert, The Structure of Technical English, Longman, 1972.
3. S. Berland-Delepine, Grammaire méthodique de l'anglais moderne avec exercices, Ophrys, 1982.
4. Test of English as a Foreign Language – Preparation Guide, Cliffs, 1991.
5. R. Fowler, The Little, Brown Handbook, Little, Brown Company, 1980.
6. Cambridge – First Certificate in English, Cambridge books, 2008.
7. K. Wilson, Th. Healy, First Choice, Oxford, 2007.
8. M. Mann, S. Tayore-Knowles, Destination : Grammar & Vocabulary with Answer Key, MacMillan, 2006.
9. E. Hamby, Ph. Bedford Robinson, Special English Computer Applications, Cassell, 1980.
10. P. Charles Brown, Norma D. Mullen, English for Computer Science, Oxford University Press, 1989.

11. Graeme Kennedy, Structure and Meaning in English: A Guide for Teachers, Pearson, 2004.
12. Anne M. Hanson, Brain-Friendly Strategies for Developing Student Writing Skills, 2nd Edition, Corwin Press, 2008.
13. Ann Bridges, How to Pass Higher English, Hodder Gibson-Hachette, 2009.

Claude Renucci, Anglais : 1000 Mots et expressions de la presse : Vocabulaire et expressions du monde économique, social et politique, Fernand Nathan, 2006.

Semestre: 3
Teaching Unit: FTU 2.1.1
Material 1: Mathematics 3
SHV: 67h30 (Course: 3h00, Tutorials: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

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

Recommended prior knowledge

Mathematics 1 and Mathematics 2

Content of the material:

Chapter 1: Simple and multiple integrals 3 weeks
1.1 Reminders on the Riemann integral and on the calculation of primitives. 1.2 Double and triple integrals.
1.3 Application to the calculation of areas, volumes, etc.
Chapter 2: Improper integrals 2 weeks
2.1 Integrals of functions defined on an unbounded interval. 2.2 Integrals of functions defined on a bounded interval, infinite at one of the ends.
Chapter 3: Differential equations 2 weeks
3.1 Reminder of ordinary differential equations. 3.2 Partial differential equations. 3.3 Special functions.
Chapter 4: 3-week series
4.1 Numerical series. 4.2 Sequences and series of functions. 4.3 Integer series, Fourrier series.
Chapter 5: Fourier Transformation 3 weeks
5.1 Definition and properties. 5.2 Application to the resolution of differential equations.
Chapter 6: Laplace transformation 2 weeks
6.1 Definition and properties. 6.2 Application to the resolution of differential equations.

Evaluation method:

Continuous control 40%; Final exam: 60%.

Bibliographic references:

1- F. Ayres Jr, Théorie et Applications du Calcul Différentiel et Intégral - 1175 exercices corrigés, McGraw-Hill.
2- F. Ayres Jr, Théorie et Applications des équations différentielles - 560 exercices corrigés, McGraw-Hill.
3- J. Lelong-Ferrand, J.M. Arnaudiès, Cours de Mathématiques - Equations différentielles, Intégrales multiples, Tome 4, Dunod Université.
4- M. Krasnov, Recueil de problèmes sur les équations différentielles ordinaires, Edition de Moscou
5- N. Piskounov, Calcul différentiel et intégral, Tome 1, Edition de Moscou
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, Transformées de Laplace, Cours et problèmes, 450 Exercices corrigés, McGraw-Hill.

Semester: 3
Teaching Unit: FTU 2.1.1
Material 2: Waves and vibrations
SVH: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives

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

Recommended prior knowledge

Mathematics 2, Physics 1 and Physics 2

Content of the material:

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

Part A: Vibration

Chapter 1: Introduction to Lagrange equations 2 weeks

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

Chapter 2: Free oscillations of systems with one degree of freedom 2 weeks

2.1 Undamped oscillations
2.2 Free oscillations of damped systems

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

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

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

4.1 Introduction
4.2 Systems with two degrees of freedom

Chapter 5: Forced oscillations of systems with two degrees of freedom 2 weeks

5.1 **Lagrange equations**

5.2 Mass-spring-damper system

5.3 Impedance

5.4 Applications

5.5 Generalization to systems with n degrees of freedom

Part B: Waves

Chapter 1: One-dimensional propagation phenomena 2 weeks

1.1 General and basic definitions

1.2 Propagation equation

1.3 Solution of the propagation equation

1.4 Sinusoidal traveling wave

1.5 Superposition of two progressive sinusoidal waves

Chapter 2: Vibrating strings 2 weeks

2.1 Wave equation

2.2 Harmonic traveling waves

2.3 Free oscillations of a string of finite length

2.4 Reflection and transmission

Chapter 3: Acoustic waves in fluids 1 week

3.1 Wave equation

3.2 Speed of sound

3.3 Sinusoidal traveling wave

3.4 Reflection-Transmission

Chapter 4: Electromagnetic waves 2 weeks

4.1 Wave equation

4.2 Reflection-Transmission

4.3 Different types of electromagnetic waves

Evaluation method:

Continuous control 40%; Final exam: 60%.

Bibliographic references:

1. H. Djelouah ; Vibrations et Ondes Mécaniques – Cours & Exercices (site de l'université de l'USTHB : perso.usthb.dz/~hdjelouah/Coursvom.html)
2. T. Becherrawy ; Vibrations, ondes et optique ; Hermes science Lavoisier, 2010
3. J. Brac ; Propagation d'ondes acoustiques et élastiques ; Hermès science Publ. Lavoisier, 2003.
4. R. Lefort ; Ondes et Vibrations ; Dunod, 2017
5. J. Bruneaux ; Vibrations, ondes ; Ellipses, 2008.
6. J.-P. Perez, R. Carles, R. Fleckinger ; Electromagnétisme Fondements et Applications, Ed. Dunod, 2011.
7. H. Djelouah ; Electromagnétisme ; Office des Publications Universitaires, 2011.

Semester : 3
Teaching Unit: FTU 2.1.2
Material 1: Fluid mechanics
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient: 2

Teaching objective:

Introduce the student into the field of fluid mechanics, fluid statics will be detailed in the first part. Then in the second part the study of the movement of nonviscous fluids will be considered

Recommended prior knowledge: mathematics, integral calculus.

Chapter 1: General information on fluid mechanics. (02 weeks)

I.1 What is Fluid Mechanics?;
I.2 Description of the movement.;
I.3 Streamlines and trajectories.;
I.4 Flow configurations: velocity profiles.;
I.5 Reminders of vector analysis and elements of index calculation.

Chapter 2: Physical properties of fluids. (02 weeks)

II.1 Density;
II.2 Isothermal compressibility;
II.3 Surface tension;
II.4 Viscosity;
II.5 Mathematical problem of fluid mechanics;
II.6 Particle derivative;
II.7 Boundary conditions;
II.8 Dimensions, dimensional equations and units.

Chapter 3: Hydrostatics. (03 weeks)

III.1 Fundamental law of hydrostatics;
III.2 Hydrostatic pressure in an incompressible fluid.
III.3Compressible fluid: ideal gas,
III.4 Resulting from hydrostatic pressure forces.;
III.5 Force exerted on a wall by a fluid.;
III.6 Archimedes' thrust.

Chapter 4: Conservation of mass. (02 weeks)

IV.1 Leibniz's theorem;
IV.2 Continuity Equation;
IV.3 Conservation of flow.

Chapter 5: Perfect Fluid. (05 weeks)

V.1 Mechanical Reminders;
V.2 Momentum theorem.
V.3 Euler equations.;
V.4 Bernoulli's theorem.,
V.5. Examples of application of Bernoulli's Theorem: Pitot probe; Venturi nozzle; Unsteady emptying of a tank;
V.6 Air exhaust from a pressure tank: compressibility limit.

Evaluation method:

Continuous control 40%; Final examination:60%

Bibliographic References:

R.Comolet,'Mécanique des fluids expérimentale',Tome1,2et3,Ed.MassonetCie.R.Ouzia ux,'Mécaniquedesfluidesappliquée',Ed.Dunod,1978 B.R.Munson,D.F.Young,T.H.Okiishi,'Fundamental sof fluid mechanics',Wiley&sons.R.V.Gilles, 'Mécaniquedesfluidesethydraulique:Coursetproblèmes',SérieSchaum,McGrawHill,1975. C.T.Crow,D.F.Elger,J.A.Roberson,'Engineeringfluidmechanics',Wiley&sons R.W.Fox,A.T.McDonald,'Introductiontofluidmechanics',fluidmechanics'V.L.Str eeter,B.E.Wylie,'Fluidmechanics',McGrawHill F.M.White,''Fluidmechanics',McGrawHill S. Amiroudine,J. L. Battaglia,'MécaniquedesfluidesCoursetexercicescorrigés',Ed.Dunod

-N. Midoux, Mécanique et rhéologie des fluides en génie chimique, *Ed. Lavoisier, 1993*.

- M. Fourar, Equations générales, solides élastiques, fluides, turbomachines, similitude, *Ed. Ellipses, 2ème Edition 2015*.

Semester :3
Teaching Unit: FTU 2.1.2
Material1: Mineral Chemistry
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient: 2

Teaching objectives:

Provide basic notions of mineral chemistry Learning of some methods such as crystal chemistry and synthesis.

Recommended prior knowledge

Basic notions of general chemistry

Material content

Chapter 1: Reminders of some important definitions: 1 week

Mole, Molar mass, molar volume, Molar fraction, mass fraction, volume fraction; Density, density; Relationship between mass fraction and mole fraction; Material balance: Concept of reagent and excess reagent, Concept of excess percentage, Concept of conversion percentage

Chapter2:Crystalchemistry3 weeks

Polyhedral description of structures, connectivity.

Chapter 3: Periodicity and in-depth study of the properties of the elements: 3 weeks

Halogens, Chalcogens, nitrogen, phosphorus, boron.

Chapter4: The great metallurgies4 weeks

(Fe,Ti,Cu,Mg)

Chapter 5: The great mineral syntheses 4 weeks

(H_2SO_4,H_3PO_4,NH_3,HNO_3)

Evaluation method:

Continuous control 40%; Final examination: 60%

Bibliographic references:

Ouahès, R, Devallez, B. Chimie Générale. Exercices et Problèmes enseignement supérieur 1er cycle. Edition Publisud.

Winnacker Karl 1903. Technologie minérale. Edition Eyrolles 1962, cop 1958. Traité de chimie appliquée : Chimie inorganique, Chimie industrielle, Industries chimiques,Génie Chimique.

Semester: 3
Teaching Unit: MTU2.1
Material 1: Probability and statistics
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Crrdits: 4
Coefficient: 2

Objectives:

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

Recommended prior knowledge

Mathematics 1 and Mathematics 2

Material content:

Part A: Statistics

Chapter 1: Basic Definitions (1 week)

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

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

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

Chapter 3: Two-variable statistical series (3 weeks)

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

Part B: Probabilities

Chapter 1: Combinatorial analysis (1 Week)

B.1.1 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 Probabilized 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.4.1 Distribution function,

B.4.2 B.4.2 Mathematical expectation,

B.4.3 B.4.3 Covariance and moments.

Chapter 5: Usual discrete and continuous probability laws (3 Weeks)

B.4.4 Bernoulli, binomial, Poisson, ... ; Uniform, normal, exponential,...

Evaluation method:

Continuous control 40%; Final exam: 60%.

Bibliographic references:

1. D. Dacunha-Castelle and M. Duflo. Probabilités et statistiques : Problèmes à temps fixe. Masson, 1982.
2. J.-F. Delmas. Introduction au calcul des probabilités et à la statistique. Polycopié 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. Cours de statistique mathématique. Economica, 1988.
7. A. Montfort. Introduction à la statistique. Ecole Polytechnique, 1991

Semester: 3
Teaching Unit: MTU2.1
Material 2: Computer science 3
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Objectives:

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

Recommended prior knowledge:

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

Content of the material:

PW 1: Presentation of a scientific programming environment (1 Week) (Matlab, Scilab, etc.)

PW 2: Script Files and Types of Data and Variables (2 Weeks)

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

PW 4: Vectors and matrices (2 Weeks)

PW 5: Control instructions (for and while loops, if and switch statements)(2 Weeks) TP 6: Function files (2 Weeks)

PW 7: Graphics (Management of graphic windows, plot) (2 Weeks)

PW 8: Using toolbox (2 Weeks)

Evaluation method:

Continuous control: 100%.

Bibliographic references:

1. Jean-Pierre Grenier, Débuter en algorithmique avec MATLAB et SCILAB, Ellipses, 2007.
2. Laurent Berger, Scilab de la théorie à la pratique, 2014.
3. Bégyn Arnaud, Gras Hervé, Grenier Jean-Pierre, Programmation et simulation en Scilab, 2014.
4. Thierry Audibert, Amar Oussalah, Maurice Nivat, Informatique : Programmation et calcul scientifiqueen Python et Scilab classes préparatoires scientifiques 1er et 2e années, Ellipses, 2010.

Semester: 3
Teaching Unit: MTU2.1
Material 3: Drawing technique
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

This teaching will allow students to acquire the principles of representing parts in industrial drawing. Even more, this subject will allow the student to represent and read the plans.

Recommended prior knowledge

(brief description of the knowledge required to be able to follow this course – Maximum 2 lines).
In order to follow this course, basic knowledge of the general principles of drawing is required.

Content of the subject

Chapter 1: General. 2 weeks

1.1 Usefulness of technical drawings and different types of drawings.

1.2 Drawing materials.

1.3 Standardization (Types of lines, Writing, Scale, Drawing and folding format, Cartridge, etc.).

Chapter 2: Elements of descriptive geometry 6 Weeks

2.1 Notions of descriptive geometry.

2.2 Orthogonal projections of a point - Sketch of a point - Orthogonal projections of a straight line (any and particular) - Sketch of a straight line - Traces of a straight line - Projections of a plane (Any and particular positions) - Traces of a plan.

2.3 Views: Choice and arrangement of views – Dimensions – Slope and conicity – Determination of the 3rd view from two given views.

2.4 Method of executing a drawing (layout, 45° straight line, etc.) Application exercises and evaluation (PW).

Chapter 3: Perspectives 2 Weeks

Different types of perspectives (definition and purpose). Application exercises and evaluation (PW).

Chapter 4: Cuts and Sections 2 Weeks

4.1 Sections, standardized representation rules (hatching).

4.2 Projections and sections of simple solids (Projections and sections of a cylinder, a prism, a pyramid, a cone, a sphere, etc.).

4.3 Half-cut, Partial cuts, broken cuts, Sections, etc.

4.4 Technical vocabulary (terminology of machined shapes, profiles, piping, etc. Application exercises and evaluation (PW).

Chapter 5: Quotation **2 Week Rating**

5.1 **General principles**.

5.2 Rating, tolerance and adjustment. Application exercises and evaluation (PW).

Chapter 6: Concepts on definition and overall drawings and parts lists.1 week

Application exercises and evaluation (PW).

Evaluation method:

Continuous control: 100%.

Bibliographic references:

(Selon la disponibilité de la documentation au niveau de l'établissement, Sites internet...etc.)

1. Guide du dessinateur industriel Chevalier A. Edition Hachette Technique;
2. Le dessin technique 1er partie géométrie descriptive Felliachi d. et Bensaada s. Edition OPU Alger;
3. Le dessin technique 2er partie le dessin industriel Felliachi d. et bensaada s. Edition OPU Alger;
4. Premières notions de dessin technique Andre Ricordeau Edition Andre Casteilla;
5. **الصناعي الرسم إلى المدخل** الجزائر الجامعية المطبوعات ديوان الحميد عبد ماجد
6. **الصناعي الرسم في أساسية مبادئ** الجامعية المطبوعات ديوان الحميد طبع الصناعية والملكية للتقييس الجزائري المعهد حنيك أبو عمر الجزائر

Recommendation: A large part of the practical work must be in the form of personal work at home.

Semester: 3
Teaching Unit: MTU 2.1
Material 4: Waves and vibrations Lab
SHV: 15h00 (PW: 1h00)
Credits: 1
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

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

Content of the material:

PW1: Mass – spring
PW 2: Simple pendulum
PW 3: Torsion pendulum
PW4: Oscillating electrical circuit in free and forced mode
PW 5: Coupled pendulums
PW 6: Transverse oscillations in vibrating strings
PW 7: Grooved pulley according to Hoffmann
PW 8: Electromechanical systems (The electrodynamic loudspeaker)
PW 9: Pohl's pendulum
PW 10: Propagation of longitudinal waves in a fluid.

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

Evaluation method:

Continuous control: 100%.

Bibliographic references:

Semester: 3
Teaching Unit: DTU2.1
Material 1: Industrial HSE installations
SHV: 22h30 (course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

- Identify and assess the risk;
- Implement appropriate prevention methods;
- Check the reality and effectiveness of the measures put in place.

Recommended prior knowledge

/

Content of the subject

Chapter 1: Introduction to risk assessment and control, Accident analysis
7 weeks

1.1 Understand the basic concepts (danger, risk) and identify those involved in prevention;
1.2 Control indicators relating to workplace accidents (frequency rate, severity rate, etc.) and occupational illnesses;
1.3 Observe and analyze the risks linked to a work situation;
1.4 Develop a tree of causes;

Chapter 2: Introduction to occupational health and environmental protection
8 weeks

2.1 Identify the main aspects of hygiene and public health;
2.2 Know the concepts of home hygiene;
2.3 Know the main areas of environmental protection;
2.4 Understand the issue of sustainable development;
2.5 identify the role and mission of the different organizations in terms of occupational health and safety and public health.

Evaluation method:

Final exam: 100%.

Bibliographic references:

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

Semester: 3
Teaching Unit: DTU 2.1
Material 2: Regulations and standards
SHV: 22h30 (course: 1h30)
Credits: 1
Coefficient : 1

Teaching objectives

This course aims to introduce students to regulation and standardization and to instill in them the importance of both in the industrial field. Students will thus be prepared to comply with regulations and use standards.

Recommended prior knowledge

Content of the subject

Chapter 1: Introduction 3 weeks

1.1 Regulations and regulatory texts.

1.2 Economic development and standardization.

Chapter 2: Normalization 4 weeks

2.1 Purpose and development. Association and standardization bodies.

2.2 International standardization. Standardization in Algeria: INAPI.

Chapter 3: Standardization of production 4 weeks

3.1 Normative parameters. Interchangeability of products. Tolerances and adjustments.

3.2 Conformity control methods, certification.

Chapter 4: Classification 4 weeks

Product classification. Classification of standards and their codification.

Evaluation method:

Final exam: 100%.

Bibliographic references:

(Depending on the availability of documentation at the establishment level, websit

Semester: 3
Teaching Unit: TTU 2.1
Material 1: English technique
SHV: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge:

English 1 and English 2

Content of the material:

- Oral comprehension and oral expression, vocabulary acquisition, grammar, etc.
- Nouns and adjectives, comparisons, following and giving instructions, identifying things.
- Use of numbers, symbols, equations.
- Measurements: Length, surface, volume, power, etc.
- Describe scientific experiments.
- Characteristics of scientific texts.

Evaluation method:

Final exam: 100%.

Bibliographic 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: FTU 2.2.1
Material1: Chemistry of solutions
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient : 2

Teaching objective:

This involves giving the student the basic notions relating to the chemistry of solutions. It is a course which essentially aims to familiarize the student with the reasoning of chemistry in solution in order to subsequently be able to predict chemical reactions for analytical purposes. It is mainly about:
- Understand the concept of electrolyte and conductivity of a solution,
- Know how to calculate the pH of an aqueous solution,
- Understand the concept of oxidant and reducer and predict redox reactions.

Recommended prior knowledge: Basic notions of general chemistry.

Content of the material:

Chapter 1: Solutions 3 weeks
Definitions: Concentrations: molarity, normality, molality, titer, mole and mass fraction, activity etc.
. Conductimetry: mobility of ions, electrolytes (strong, weak), conductivity (specific and molar), conductometric cell, Kohlrausch law, conductometric dosage

Chapter 2: Acids-Bases 3 weeks
-Acid-base balances in aqueous solution: acidity scale, acidity constant (Ka, pKa), dilution law (Oswald), pH calculation (simple solutions, mixtures, salines, buffer solutions, ampholyte solutions), forecasts reaction, acid-base dosages (polyacids and polybases).
- Colored indicators

Chapter 3: Redox 3 weeks
Definition, Oxidant, reducer, Redox reactions, Oxidation state and number, Balancing of redox reactions, Electrochemical batteries, Thermodynamic aspect, Electrodes

Chapter 4: Solubility 3 weeks
Definition, Graphical representation, Common ion effect, Influence of pH on solubility (case of hydroxides), Influence of potential on solubility, Influence of complexation on solubility

Chapter 5: Complexes 3 weeks
Definition, Nomenclature of complexes, Formation of complexes, Stability of complexes, Effect of pH on complexes, Effect of potential on complexes, Some areas of application of complexes

Evaluation method:
Continuous control 40%; Final exam: 60%.

References:

1- John Hill , Ralph Petrucci, Terry McCreary , Scott Perry, Chimie des Solutions, 2ème Ed, ,Edition ERPI ; 2014.
2- John C. Kotz, Chimie des Solutions, Edition de Boeck 2006.

Semester : 4
Teaching Unit: FTU 2.2.1
Material 1: Organic chemistry
SHV: 45h00 (Course: 1h30, Ttutorials: 1h30)
Credits : 4
Coefficient: 2

Teaching objectives:

- Introduce the basic notions of organic chemistry and present the main functional derivatives with a view to understanding industrial chemistry processes.
- Description of the mechanisms for obtaining different functions and the main reactions are met in organic chemistry.

Recommended prior knowledge:

Basic knowledge of carbon, notions of chemical bonding.

Material content:

Chapter 1: General 3 weeks

Study of the carbon atom and these bonds

Functions and nomenclature of organic compounds: Ordinary, trivial, usual and systematic IUPAC nomenclature

Chapter 2: Classification of organic functions 2 weeks

Saturated aliphatic hydrocarbons (linear, branched), Alkenes (preparation, reactivity), Aromatic compounds (preparation, reactivity), Alcohols, thiols, aldehydes (preparation, reactivity), Ketones, carboxylic acids (preparation, reactivity).

Chapter 3: Notions of stereo-Isomerism4 weeks

Definition, Plane isomerism (definition), Functional isomerism, Position isomerism, Tautomerism, geometric isomerism, Stereochemistry: definition, representation of molecules in space, configurational isomerism.

Chapter4: Electronic effects 3 weeks

-Definition, Chemical bonds: pure covalent, polarized covalent andionic. Inductive effect: definition, Classification of waves, inductive effects, Influence of the inductive effect on the acidity of a chemical compound, Influence of the inductive effect on the basicity of a chemical compound.

Mesomeric effect: definition, conjugate systems and electron delocalization.

Classification of mesomeric effects, Influence of the mesomeric effect on the acidity of a chemical compound

, Influence of the mesomer effect on the basicity of an organic compound

Chapter 5: The major reactions in organic chemistry 3 weeks

Reagents and reaction intermediates; Classification of reactions: Addition; Substitution; Elimination; Rearrangement; Elementary rules: Markovnikov, Zeitsev;

Evaluation method:

Continuous control 40%; Final examination: 60%.

References:

1-PaulArnaud, Chimieorganique,DUNOD;2004.

2- JeanpierreMercier,PierreGaudardChimieorganique:uneinitiation;Pressespolytechniques Romandes2001.

3- MelaniaKielChimieorganiquecoursetexercicescorrigés;;estem;2004.

4- JonathanClayden,NickGreeves,StuartWarren,AndréPousse,Chimieorganique; deBoeck2e édition;2013.

5- JohnMcMurry,EricSimanek,Chimieorganiquelesgrandsprincipes;DUNOD2e édition; 2007.

Semester :4
Teaching Unit: FTU 2.2.2
Material1: Chemical thermodynamics
SHV: 45h00 (Course: 1h30, Tutorial: 1h30)
Credits : 4
Coefficient: 2

Teaching objectives:
-mastery of the 1st and 2nd and 3rd principles of thermodynamics.
-The application of thermodynamic principles
-The study of chemical balances, chemical potential, as well as real gases.

Recommended prior knowledge:
Differential equations, basic chemical thermodynamics (S2 of the common base ST).

Material content:
Chapter I: Reminders in thermodynamics (2 weeks)
I.1 Mathematical reminder of partial derivatives
I.2 State variables and functions
I.3 Thermodynamic quantities and systems
I.4 The different principles of thermodynamics
I.5 Criterion for evolution of a system and chemical potential
Chapter II: Thermodynamic properties of pure substances (4 weeks)
II.1 The ideal gas
II.2 Intermolecular forces and real behavior of gases
II.3 Equations of state of real gases
II.4 Corresponding states, residual differences and transience
II.5 Thermodynamic properties of condensed states
Chapter III: Phase equilibria of a pure substance (4 weeks)
II.1 General equilibrium relations (Clapeyron and Clapeyron-Clausius)
II.2 Liquid-vapor, liquid-solid and solid-vapor equilibria
II.3 Stable and unstable equilibria and phase transition
II.4 Generalized diagrams
Chapter IV: Chemical Equilibria (5 weeks)
IV.1 The affinity of a chemical reaction
IV.2 Monothermal-monobaric and monochoric systems
IV.3 Heat of a chemical reaction and the laws of Hess and Kirchoff
IV.4 Law of mass action and shift in chemical equilibrium

Evaluation method:
Continuous control 40%;Final examination:60%.

References
Smith, E.B, Basic Chemical Thermodynamics, second ed., Clarendon Press, Oxford, 1977.
Rossini, F. D., Chemical Thermodynamics, Wiley, New York, 1950. Florence,
Stanley I.Sandler,Chemical and Engineering Thermodynamics, Wiley, New York, 1977.
Elliot,J, Lira C.T, Introductory chemical engineering Thermodynamics , Prentice –Hall (1999)
Lewis G.N., Randal M., Thermodynamics, Mac Graw Hill
Hougen O.A., Watson K.M., Chemical process principles, Vol II: thermodynamics John Wiley and sons

Semester :4
Teaching Unit: FTU 2.2.2
Material 2: Numerical methods
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient: 2

Teaching objectives:

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

Recommended prior knowledge:

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

Content of the material:

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

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

Chapter 2. Polynomial interpolation (2 Weeks)

1. General introduction, 2. Lagrange polynomial, 3. Newton polynomials.

Chapter 3. Function approximation: (2 Weeks)

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

Chapter 4.Digital integration (2 Weeks)

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

Chapter 5. Solving ordinary differential equations (Problem of the initial condition or Cauchy) (2 Weeks)

1. General introduction, 2. Euler method, 3. Improved Euler method, 4. Runge-Kutta method.

Chapter 6. Direct solution method for systems of linear equations (2 Weeks)

1. Introduction and definitions, 2. Gauss method and pivot, 3. LU factorization method, 4. ChoeleskiMMt factorization method, 5. Thomas algorithm (TDMA) for three-diagonal systems.

Chapter 7. Approximate solution method for systems of linear equations (2 weeks)

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

Evaluation method:

Continuous control 40%; Final exam: 60%.

Bibliographic references:

1. C. Brezinski, Introduction à la pratique du calcul numérique, Dunod, Paris 1988.

2. G. Allaire et S.M. Kaber, Algèbre linéaire numérique, Ellipses, 2002.
3. G. Allaire et S.M. Kaber, Introduction à Scilab. Exercices pratiques corrigés d'algèbre linéaire, Ellipses, 2002.
4. G. Christol, A. Cot et C.-M. Marle, Calcul différentiel, Ellipses, 1996.
5. M. Crouzeix et A.-L. Mignot, Analyse numérique des équations différentielles, Masson, 1983.
6. S. Delabrière et M. Postel, Méthodes d'approximation. Équations différentielles. Applications Scilab, Ellipses, 2004.
7. J.-P. Demailly, Analyse numérique et équations différentielles. Presses Universitaires de Grenoble, 1996.
8. E. Hairer, S. P. Norsett et G. Wanner, Solving Ordinary Differential Equations, Springer, 1993.
9. P. G. Ciarlet, Introduction à l'analyse numérique matricielle et à l'optimisation, Masson, Paris, 1982.

Semester :4
Teaching Unit: FTU 2.2.3
Matetial 1: Chemical kinetics
SHV: 22h30 (Course: 1h30)
Credits : 2
Coefficient: 1

Objectives:

Provide the student with the essential bases for any kinetic study of a chemical process and covers both the elementary notions of formal kinetics and the mathematical bases concerning the notion of speed of a chemical reaction and its evolution over time, the parameters influencing the speed of a reaction, the determination of the order of a reaction by physicochemical methods, the rate constant and the activation energy.

Recommended prior knowledge:

Mathematics (derivative, integral), knowing how to express the concentration of a solution, mastering unit systems, knowing how to draw and use graphs.

Material content:

Chapter I. Homogeneous chemical reactions (1 week)

I. Reaction speed (absolute speed, specific speed)
II. Experimental kinetic study of a reaction (Chemical and physical methods
III. Experimental factors influencing speed

Chapter II. Influence of concentrations and temperature on speed (2 weeks)

I. Influence of concentration (Order of a reaction, Molecularity and Stoichiometry of a reaction, VANT'HOFF rule
II. Influence of temperature

Chapter III. Formal kinetics, simple reaction (6 weeks)

I. Determination of the rate constant of a reaction of given order (Order 0,1,2,3 and n)
II. Determination of reaction orders
-Methods for determining the order by Integration (variation of concentrations as a function of time, partial reaction time methods), example of calculation
- Differential method, calculation example
- Methods based on order degeneracy, calculation example
- Method using dimensionless parameters, calculation example

Chapter IV. Compound reactions (6 weeks)

1. Opposite or balanced reactions
-General
- Examples of opposite reactions (the two opposite reactions are of order 1, of order 2, reactions of order 2 opposed to reaction of order 1, reactions of order 1 opposed to reaction of order 2)
-Balance and speed of reactions
-Principle of microreversibility
2. Parallel reactions: generalities, twin reactions, competing reactions, example,
3. Successive reactions: determination of rate constants, radioactive equilibrium, example of calculation.

Evaluation method:

Final exam: 100%.

Reference Reference:

1 ClaudeMoreau,Jean-PaulPayen,Cinétiquechimique,EditionBelin1999

2 MichelDestriau,GérardDorthe,RogerBen-Aïm,Cinétiqueetdynamiquechimique EditionTechnip1981.

3 P.Morlaes,Cinétiquechimique:Structuredelamatière1978

4 B.Frémaux,Elémentsdecinétiqueetdecatalyse,EditeurTecet1998

5 M. Robson Wright, An Introduction to Chemical Kinetics, Editions John Wiley & Sons Ltd, Chichester, 2004

6 P. William Atkins, Eléments de Chimie Physique, Editions DeBoek Université, Bruxelles, 1997

7 E. James House, Principles of Chemical Kinetics, 2ème édition, Editions Elsevier Inc., London, 2007

8 A. Azzouz, Cinétique Chimique, Editions Berti, Tipaza, 1991

9 A. Derdour, Cours de Cinétique Chimique, Editions OPU, Alger, 1988

10 G. Scacchi, M. Bouchy, J. F. Foucaut et O. Zahraa, Cinétique et Catalyse, Editions Technique & Documentation, Paris, 1996

11 Thermodynamique chimique, M. A. OTiuran et M. Robert., Presses Universitaires de Grenoble, 1997, 245 pages.

12 Chimie générale, R Ouahès, B Devallez, PUBLISUD 4 ème Ed, 1997, 504 pages.

13 Chimie générale, S. S. ZUMDAHL., De Boeck Université 2ème Ed, 1999, 514 pages.

14 Eléments de chimie physique, P.W. ATKINS., De Boeck Université 2ème Ed, 1996, 512pages.

15 Chimie générale, Élisabeth Bardez, Dunod Paris, 2009, 258 pages.

16 Les cours de Paul Arnaud, Exercices résolus de chimie physique.,Dunod Paris 3 ème Ed, 2008, 386 pages.

17 La chimie générale au PCEM, tome 1, C. Bellec, G. Lhommet., Vuibert, 1996, 307 pages.

Semester : 4
Teaching Unit: MTU 2.2
Material 1: Chemistry of solutions Lab
SHV: 22h30 (PW: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives:

Understand and assimilate knowledge well.

Recommended prior knowledge

Concepts of general chemistry and thermodynamics. The student has already been familiarized with laboratory equipment and glassware.

Content of the material:

PWN°1. Determination of water hardness by complexometry.

PWN°2. Experimental verification of Nernst's law.

PWN°3. Conductometric dosage of vinegar.

PWN°4. Dosage, monitored by pH meter, of the alkalinity of an aqueous solution using a hydrochloric acid solution. Gran's method.

PWN°5. Dosage, monitored by pH-metry and conductimetry of a sodium hydroxide solution.

PWN°6. Search for cations of the first group.

PWN°7. Determination of the solubility product of a poorly soluble salt.

PWN°8. Measurement of the formation constant of a complex.

PWN°9. Potential diagram - pH of Iron.

Evaluation method:

Continuous control: 100%.

Reference:

G. Milazo. Electrochimie. Dunod 1969

Brenet. Introduction à l'électrochimie de l'équilibre et du non équilibre. Masson 1980

Semester : 4
Teaching Unit: MTU 2.2
Material 2: Organic chemistry Lab
SHV: 15h00 (PW: 1h00)
Credits : 1
Coefficient : 1

Teaching objectives:

Preparation and analysis of organic products presenting the main functions encountered in organic chemistry (alcohols, acids, aldehydes, ketones, etc.)

Recommended prior knowledge:

organic chemistry

Content of the material:

PWN°1. Esterification (Synthesis of aspirin).

PWN°2. Purification by recrystallization of Benzoic acid.

PWN°3. Extraction of an organic product.

PWN°4.Determination of the composition of a mixture by refractometry.

PWN°5. Sublimation of Naphthalene.

PWN°6. Study of the properties of phenol or an organic substance.

PWN°7. Preparation of soap.

PWN°8. Transformation of an alcohol into a halogenated derivative (synthesis of 2-chloro-2-methylpropane from 2-methylpropan-2-ol).

PWN°09: Purification by distillation at atmospheric pressure and steam entrainment

PWN°. 10: Purification by fractional distillation on a column

Evaluation method:

Continuous control: 100%.

Semester : 4
Teaching Unit: MTU2.2
Material3: Fluid mechanics Lab
SHV: 22h30 (PW: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives:

The student puts into practice the knowledge in the fluid mechanics subject taught in S3.

Recommended prior knowledge:

Subjects: fluid mechanics and physics 1.

Content of the material:

- **PW No. 1**. Viscometer
- **PW No. 2.** Determination of linear and singular pressure losses
- **PW No. 3.** Flow measurement
- **PW No. 4.** Water hammer and mass oscillations
- **PW No. 5.** Verification of Bernoulli's theorem
- **PW No. 6.** Impact of the jet
- **PW No. 7.** Flow through an orifice
- **PW No. 8.** Visualization of flows around an obstacle
- **PW No. 9.** Determination of the Reynolds number: Laminar and turbulent flow

Evaluation method:

Continuous control: 100%.

Semester: 4
Teaching Unit: MTU2.2
Material 4: Numerical methods Lab
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

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

Recommended prior knowledge

Numerical method, Computer science 2 and Computer science 3.

Content of the material:

Chapter 1: Solving nonlinear equations 3 weeks

1.Bisection method. 2. Fixed point method, 3. Newton-Raphson method

Chapter 2: Interpolation and approximation 3 weeks

1. Newton interpolation, 2. Chebyshev approximation

Chapter 3: Digital integrations 3 weeks

1. Rectangle method, 2. Trapeze method, 3. Simpson method

Chapter 4: Differential equations 2 weeks

1.Euler method, 2. Runge-Kutta methods

Chapter 5: Systems of linear equations 4 weeks

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

Evaluation method:

Continuous control: 100%.

Bibliographic references:

1. José Ouin, Algorithmique et calcul numérique : Travaux pratiques résolus et programmation avec les logiciels Scilab et Python, Ellipses, 2013.
2. Bouchaib Radi, Abdelkhalak El Hami, Mathématiques avec Scilab : guide de calcul programmation représentations graphiques ; conforme au nouveau programme MPSI, Ellipses, 2015.

Jean-Philippe Grivet, Méthodes numériques appliquées : pour le scientifique et l'ingénieur , EDP sciences, 2009.

Semester : 4
Teaching Unit: MTU 2.2
Material 1: Chemical kinetics Lab
SHV: 22h30 (PW: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives:

-Measurement of the reaction speed from the relationship "Concentration = f(t)"

-Determination of the order; Evaluation of the speed constant and activation energy.

- Use linear regression to process curves

Recommended prior knowledge:

Content of the material:

- Chemical method (monitored by volumetric method):

- Saponification of an ester (ethyl ethanoate with sodium hydroxide):

RCOOR' + NaOH = RCOONa + R'OH

- Physical method

- Polarimetry: kinetics of sucrose inversion.

- Spectrophotometry: Decomposition of a Mn3+ complex

- Conductometric method: Saponification of an ester (ethyl ethanoate with sodium hydroxide)

- Volume measurement: Decomposition of hydrogen peroxide (hydrogen peroxide)

Evaluation method:

Continuous control: 100%.

Semester : 4
Teaching Unit : DTU 2.2
Material 1: Introduction to Refining and Petrochemicals
SHV: 22h30 (course: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives:

Explain the genesis of fossil fuels. Master the nomenclature and specifications of petroleum products. Know the main refining and petrochemical processes and their products.

Recommended prior knowledge

Organic chemistry

Content of the material:

Chapter 1: Training and Exploitation of Oil and Natural Gas 4 weeks

Definition and origin of oil, Deposits and characteristics of oil, Exploitation techniques

Chapter 2: Oil refining schemes 6 weeks

Nomenclature and characteristics of petroleum products, Main manufacturing process schemes, Environmental constraints and evolution of refining

Chapter 3: Petrochemical manufacturing schemes 5 weeks

Diversity of products in the petrochemical industry, Main manufacturing routes in petrochemicals, Examples of processes (PVC, Ammonia)

Evaluation method:

Final exam: 100%.

Reference:

1- Le raffinage du pétrole en 5 tomes, Technip, 1998.

2- P. Wuithier, le pétrole, raffinage et génie chimique. TOME1, technip, 1972.3- A. Fahim,Taher A. Al-Sahhaf, A Elkilani, Fundamentals of Petroleum Refining,Elsevier,2010.

Semester : 4
Teaching Unit: DTU 2.2
Material 1: Notions of transfer phenomena
SHV: 22h30 (Course: 1h30)
Credits : 1
Coefficient: 1

Objectives:

-Demonstrate the balance equations for balance and fluid flow

-Give the basic notions of heat transfer then introduce students to calculations

-Give the basic laws which describe the matter transfer processes.

Recommended prior knowledge:

Thermodynamics and notions of kinetics

Material content:

Chapter 1: Introduction to transfer modes 3 weeks

Chapter 2: Heat transfer 4 weeks

Conduction, Convection, Radiation

Chapter 3: Material transfer 4 weeks

Transfer of matter by molecular diffusion, Transfer of matter by convection

Chapter 4: Momentum transfer 4 weeks

Properties of fluids, Statics of fluids, General conservation equations

Evaluation method:

Final exam: 100%.

Reference:

1-Transport Phenomena;BIRD(R.B).STEAWART(W.E).,J.WileyandSons.Inc.,1960.
2-Mass Transfer Operations;TREYBAL(R.E).McGraw-HillbookCy,Inc,1955.
3- Lepétrole,Raffinage et GénieChimique;P.WUITHIER,1965EditionTechnip.Paris.
4- ChemicalEngineering;COULSONetRICHARDSON.PergamonPress.Lim.,London1955.

Semester: 4
Teaching Unit: TTU 2.2
Material 1: Expression and communication techniques
SHV: 22h30 (Course: 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.

Recommended prior knowledge:

Languages (Arabic; French; English)

Material content:

Chapter 1: Research, analyze and organize information 3 weeks

Identify and use places, tools and documentary resources, Understand and analyze documents, Create and update documentation.

Chapter 2: Improving the ability to express 3 weeks

Take into account the Communication situation, Produce a written message, Communicate orally, Produce a visual and audiovisual message.

Chapter 3: Improving communication ability in interactive situations 3 weeks

Analyze the Interpersonal communication process, Improve face-to-face communication ability, Improve group communication ability.

Chapter 4: Develop autonomy, organizational and communication skills within the framework of a project approach 6 weeks

Position yourself in a project and communication approach, Anticipate action, Implement a project: Presentation of a report of practical work (homework).

Evaluation method:

Final exam: 100%.

Bibliographic references:

(Books and handouts, websites, etc.)

1- Jean-Denis Commeignes, 12 méthodes de communications écrites et orale – 4éme édition, Michelle Fayet et Dunod 2013.
2- Denis Baril, Sirey, Techniques de l'expression écrite et orale, 2008.
3- Matthieu Dubost, Améliorer son expression écrite et orale toutes les clés, Edition Ellipses 2014.

Semester 5
Teaching Unit: FTU 3.1.1
Material 1: Heat transfer
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives:

-Study of different transfer modes: conduction, convection and radiation.

-Applications of the laws governing these different types of transfer.

Recommended prior knowledge:

Thermodynamics, Differential equations.

Material content:

Chapter 1 : General introduction to the different modes of heat transfer (1 week)

Chapter 2: (6 weeks)

Heat transfer by conduction: Fourier's law Case: simple wall, composite walls, cylindrical layer, composite cylindrical layers (electrical analogy, overall resistance); Insulating the cylindrical layers (critical insulation thickness); Insulation of spherical layers. general equation of conduction, fin problems,

Chapter 3: (5 weeks)

Heat transfer by convection: Definitions; Expression of heat flow (Newton's law); heat transfer coefficient by convection, dimensional analysis, empirical correlations (natural and forced convection), Calculation of heat flow in natural convection; Calculation of heat flow in forced convection.

Chapter 4: (3 weeks)

Heat transfer by radiation: Radiation laws; Lambert's law; Kirchhoff's law; Radiation of black bodies; Radiation of non-black bodies; Reciprocal radiation of several surfaces (heat exchange by radiation between black and gray surfaces).

Evaluation method:

Continuous control 40%; Exam: 60%.

Bibliographic references:

1. J. Krabol, « Transfert de chaleur », Masson, 1990.
2. Martin Becker, "Heat transfer: a modern approach". Plenum, 1986.
3. J.F. Sacadura, « Initiation au transfert thermique », TEC-DOC, 1980.
4. Pierre Wuithier, « Le pétrole, raffinage et génie chimique ».
5. Y. Jannot, cours de transfert thermique, 2ème édition, école des mines Nancy.
6. Incorpera, Dewwitt, Bergmann, Lavine, « Fundamentals of heat and mass transfer » , 6th edition Ed. Wiley (2010)

Semester :5
Teaching Unit: FTU 3.1.1
Material 2: Material Transfer
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives:

Understand the mechanisms and formalism used to describe the transfer of matter; Know how to write a material balance necessary for calculating equipment.

Recommended prior knowledge:

Thermodynamics; Chemical kinetics; Differential equations.

Material content:

Chapter 1: Matter transfer mechanism (3 weeks)

Introduction ; Definition of molecular diffusion; Nomenclature: mass and molar concentrations, total and individual, diffusion and transport flux density (convection + diffusion); Definition of mass and molar average velocities; Fick's law and Stefan Maxwell's law (multicomponent gas systems);

Diffusion coefficients (gas phase, liquid phase, order of magnitude of diffusion coefficients in different media (gases, liquids, solids); Diffusion coefficients in porous solids; Concept of effective diffusion coefficients.

-Chapter 2: Stationary and quasi-stationary one-dimensional diffusion (3 weeks)

Material balance-Continuity equation (global and partial); Reminders about gradient operators and

divergence of a vector; Balances of the total mass and for a constituent i on an element of fixed volume; Boundary conditions and initial condition; Examples of single-variable diffusion problems (case of a gas through a stagnant gas film, evaporation problem, equimolar diffusion, applications for different geometries (plane, cylinder, sphere));; Diffusive transfer with homogeneous and heterogeneous chemical reaction.

Chapter 3: Transient diffusive transfer: (5 weeks)

Transient diffusive transfer: Fick's 2nd law; Instantaneous source problems (limited quantity of scattering material); Continuous source problems (fixed boundary condition (Learn to pose a problem with its adapted equation and its initial and boundary conditions).

-Chapter 4: Transfer of matter to an interface (between phases) (4 weeks)

Reminders of the balances between two phases; Theory of 2 films, penetration, surface renewal; Individual and overall mass transfer coefficients; Concept of dimensional analysis: π-Buchingham theorem; Dimensionless numbers relating to matter transfer (Sherwood, Reynolds, Schmidt); Estimates of mass transfer coefficients (dimensionless correlations)

Evaluation method:

Continuous control 40%; Exam: 60%.

Bibliographic references:

1. Bird, Stewart, Lightfoot, "Transport phenomena », Second Edition, J Wiley, 2002.
2. Treybal,« Mass transfer operations », Mc Graw-Hill.
3. Incorpera, Dewwitt, Bergmann, Lavine, « Fundamentals of heat and mass transfer » , 6th edition Ed. Wiley (2010)
4. Welty, Wicks, Wilson, Rorer, "Fundamentals of momentum, heat and mass transfer" 5th edition, Ed; Wiley (2007)

Semester 5
Teaching Unit: FTU 3.1.1
Material 3: Quantity Transfer of Movement
SHV: 22h30 (Course: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives:

Learn to analyze typical problems encountered in fluid mechanics (problem statement, formulation and analytical solution); Make balances of momentum and mechanical energy for simple unidirectional systems; Obtain the speed profile and deduce the other quantities of interest (flow rates, forces, pressure losses, etc.).

Recommended prior knowledge:

Basics of mathematics; Concepts in MDF.

Material content:

Chapter 1: (02 weeks)

Reminders: A- Properties of fluids, Statics of fluids, Dynamics of perfect fluids.

Chapter 2: (03 weeks)

Balances of matter, momentum and energy: 1. Conservation equation of mass; 2. Conservation equation of momentum; 3. Energy conservation equation.

Chapter 3: (05 weeks)

Fluid dynamics: 1. Stresses and strains in continuous media; 2. Equation of motion of real fluids; 3. Flow regime

Applications of the Navier and Stockes equations (poiseuille flow, duvet flow, free surface flow)

Chapter 4: (02 weeks)

Simple shear flow of non-Newtonian fluids, case of the BINGHAM fluid, case of the OSTWALD fluid

Chapter 5: (03 weeks)

Pumps and pumping: Network calculation.

Evaluation method:

Exam: 100%.

Bibliographic references:

1. Laszlo, « Les bases scientifiques du génie chimique », Dunod, 1972.
2. Robert E Treybal, "Mass tranfer operation ».Mc Graw-Hill, 1981.
3. R. B. Bird, W. E. Stewart, and E. N. Lightfoot,« Transport Phenomena », Wiley 1960.
4. Midoux Noel, Mécanique des fluides en genie chimique, Coll. Génie des procédés de l'école de Nancy.
5. R. Comolet, Mécanique des fluides réels - Tome 2, *Ed. Dunod, 2006*.
6. M. Fourar, Equations générales, solides élastiques, fluides, turbomachines, similitude, *Ed. Ellipses, 2ème Edition 2015*.

Semester : *5*
Teaching Unit: FTU 3.1.2
Material 1: Electrochemistry
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives:

Acquire the basic notions of electrochemistry, thermodynamics and electrochemical kinetics necessary for understanding electrochemical phenomena.

Recommended prior knowledge:

Chemistry of solutions. Chemical thermodynamics and notions of kinetics.

Material content:

Chapter 1: (1 week)

Reminders on electrolytic solutions: Conductivity, ion mobility, Oswald's dilution law, Kohlrausch relationship).

Chapter 2: (3 weeks)

Physical properties and quantities of electrolytes: Debye-Huckel theory: applications to calculations of activity coefficients; Solvation and hydration of ions; Faraday's laws (Gaps and returns).

Chapter 3: (5 weeks)

Thermodynamics of electrochemical reactions: Definition and preliminary reminders; Concepts of chemical potential; Electrode voltage and equilibrium potential; Concepts of electrochemical double layer and Stern model; Nernst relation and its applications; Predictions of RedOx reactions; Different types of electrodes; Electrochemical batteries and notions of junction voltage (Henderson's law).

Chapter 4: (4 weeks)

Kinetics of electrochemical reactions: Definitions; Speed of an electrochemical reaction; Electrochemical assemblies, Butler-Vollmer law; Tafel approximation.

Chapter 5: (2 weeks)

Electrochemical methods and techniques: Voltammetry; Chronopotentiometry, ...

Evaluation method:

Continuous control 40%; Exam: 60%.

Bibliographic references:

1. Genévrière ML Dumas, Roger Benaîm, l'indispensable en électrochimie, Breal, 2001.
2. G. Milazo, « Electrochimie », Dunod,1969.
3. Brenet, « Introduction à l'électrochimie de l'équilibre et du non équilibre », Masson,1980.
4. Allen J. Bard, « Electrochimie : principes, méthodes et applications », Masson, 1983.
5. Fabien Miomandre, SaïdSadki, PierreAudebert, « Electrochimie des concepts aux applications », Dunod, 2005.
6. F.Cœuret, A. Stock,« Eléments de génie électrochimique », Lavoisier Tech. &.Doc, 1993.

Semester :*5*
Teaching Unit: FTU 3.1.2
Material 2: Instrumentation - sensors
SHV: 22h30 (Course: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives:

Acquire the knowledge allowing the control and exploitation of the physical effects involved in the instrumental devices for collecting information in the measurement environment: machines, environment, etc.

Recommended prior knowledge:

Thermodynamics; Fluid mechanics ; Transfer phenomena.

Material content:

Chapter 1: (2 weeks)

Principles of measurement: Function of a measuring or control device; Overall constitution of a measuring device; Qualities of a measuring device (Zero, Scale, Linearity); Performance of a measurement chain.

Chapter 2: (2 weeks)

Pressure measurements: Absolute and differential pressure; Empty ; Pressure measuring devices; Use and assembly.

Chapter 3: (2 weeks)

Flow measurements: Flows at differential pressure, with variable orifice and area; Counters.

Chapter 4: (2 weeks)

Level measurements: Optical device, spirit level; Level measurement by the pressure due to the height of the liquid.

Chapter 5: (2 weeks)

Temperature measurements: Thermometers and thermocouples, thermistors.

Chapter 6: (5 weeks)

Sensors: Sensor physics: Simple sensors; Transduction functions; Energy and electrical aspects; Multiple transduction sensor devices: test body, acting quantity and measured quantity; Conditioning circuits: Differential bridges, Integrated conditioners, Offset and drift compensation; Applications to measurements with thermal, mechanical, electromagnetic effects and to the dosage of chemical species.

Evaluation method:

Exam : 100%.

Bibliographic references:

1. M. Cerr, J-C. Engrand, F. Rossman, « Instrumentation Industrielle », Ed Paris Technique & documentation-Lavoisier impr., 1990 Paris Impr. Jouve.
2. Michel Grout, Patrick Salaun, « Instrumentation industrielle », Collection: Technique et Ingénierie, Dunod - L'Usine Nouvelle.
3. Michel Capot,« Les principes des mesures: pressions, débits, niveaux, température »s, Editions TECHNIP.

Semester : *5*
Teaching Unit: FTU 3.1.2
Material 3: Kinetics and homogeneous catalysis
SHV: 22h30 (Course: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives:

Consolidate the basic notions of chemical kinetics (kinetic law: order, activation energy, constant rate). Acquire notions of approach to treating reaction mechanisms. Make known a branch of chemical kinetics important in different sectors: catalysis.

Recommended prior knowledge:

The basics of general chemistry (atomistics, chemical bonding, thermochemistry) and the fundamental notions of chemical kinetics.

Material content:

Chapter 1: (2 weeks)
Reminders: Simple laws of chemical reaction rates; Activation energy; Molecularity.

Chapter 2: (4 weeks)
Reaction mechanisms: Approximation of the quasi-steady state; Mechanisms by stages; Chain mechanisms.

Chapter 3: (4 weeks)
Kinetic theories: Molecular collision theory; Activated complex theory; Pseudo-monomolecular reactions.

Chapter 4: (5 weeks)
Homogeneous catalysis: General information on homogeneous catalysis; Mechanisms; Acid-base catalysis; Enzymatic catalysis.

Evaluation method:

Exam: 100%.

Bibliographic references:

1. B. Fremaux, « Eléments de cinétique et de catalyse », technique et doc. Lavoisier.
2. G. Scacchi, M. Bouchy, J. F. Foucaut, O. Zahraa, R. Fournet, « Cinétique et catalyse », Lavoisier, 2011.
3. P. Morlaes, J.C. Morlaes, « Cinétique chimique », Vuibert 1981.
4. Michelle Soustelle ; cinétique chimique, éléments fondamentaux, Lavoisier, 2011

Semester : *5*
Teaching Unit: MTU 3.1
Material 1: Analysis techniques
SHV: 37h30 (Course: 1h30, PW: 1h00)
Credits : 3
Coefficient : 2

Teaching objectives:

Know the main physical methods of analysis: principle, interest and scope of application in the field of process engineering in particular. Acquire the basics of analysis and control of raw materials and formulated products.

Recommended prior knowledge:

Elementary notions of wave-particle duality; Chemical bonds; Electronic transitions; Concepts of analytical chemistry; Chemistry of solutions.

Material content:

Chapter 1: (8 weeks)

Chromatographic methods: General information on chromatographic methods; General principle of chromatographic separation; Liquid chromatography; Gas chromatography.

Chapter 2: (3 weeks)

UV – Visible molecular spectroscopy: Principle; Theoretical notions; Equipment; Interpretation of a UV-Visible absorption spectrum.

Chapter 3: (4 weeks)

Infrared (IR) Spectroscopy: Principle; Theoretical notions; Equipment; Interpretation of an IR absorption spectrum.

Applications:

- Identifications and quantifications by HPLC and CPG
- Verification of the Beer-Lambert law
- Identification of organic functions by IR.

Evaluation method:

Continuous control: 40%; Exam: 60%.

Bibliographic references:

1. Francis Rouessac , Annick Rouessac , Daniel Cruché,«Analyse chimique : Méthodes et techniques instrumentales », 7ème Edition Dunod, 2009.
2. Gwenola Burgot, Jean-Louis Burgot,« Méthodes instrumentales d'analyse chimique et applications : méthodes chromatographiques, électrophorèses, méthodes spectrales et méthodes thermiques », 3ème Edition, Tech & Doc, 2011.
3. R.Rosset,« Chromatographie en phase liquide », Masson, 1995
4. M. Dalibart, L. Servant, « Spectroscopie dans l'infrarouge, Techniques de l'Ingénieur, traité Analyse et Caractérisation », P2845, 2000.

Semester :*5*
Teaching Unit: MTU 3.1
Material 2: Chemistry Physics 1 and Chemical Engineering1 Lab
SHV: 22h30 (PW: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives:

Observation of physical phenomena studied during lectures; Validate and correctly present the results obtained; Formulate, understand an experimental technique; Validate and correctly present the results obtained; and communicate findings.

Recommended prior knowledge:

- Chemistry of solutions, notions of kinetics, basics of thermodynamics.
- Be informed of safety instructions in a laboratory and be willing to work in a group. Basics of thermodynamics, notions of transfer phenomena.

NB: List for information only, adapt according to means;
Number of practical work to be completed = Seven(7): 4 in electrochemistry; 3 in homogeneous catalysis. 3 in Heat Transfer; 2 in Mass Transfer; 2 in TQM.

Material content:

PW. Electrochemistry

- Dissociation constant; Low electrolytes; Activity coefficient.
- Creation of an electrochemical cell.
- Plotting intensity-potential curves.
- Measurements of battery voltage as a function of temperature and error calculations.
- Corrosion of a metal.
- Electrolysis TP

PW. Kinetics and homogeneous catalysis

- Effect of the nature of the catalyst on the chemical reaction: disproportionation of H2O2 in the presence of: iron(III) chloride, platinum wire, enzyme (piece of turnip) (demonstrative TP to observe the catalytic effect and distinguish between catalysis homogeneous, heterogeneous, and enzymatic).
- Determination of the catalytic constant of the reaction of the persulfate ion with the iodide ion in the presence of CuSO4.
- Kinetic study of the iodination (bromination) reaction of acetone catalyzed by an acid or a base.

PW. Chemical engineering- 1:

- Measurement of transfer coefficient, KLa, in a mechanically stirred reactor.
- Diffusion of liquids.
- Study of heat transfer by axial and radial conduction.
- Study of heat transfer by convection.
- Study of heat transfer by radiation.
- Measurement of linear pressure losses in pipes of different diameters.
- Measurement of the coefficient of friction in smooth pipes.
- Calibration of a measuring device
- Study of the performance of a measurement sensor (class, fidelity, accuracy, speed, etc.)

Evaluation method:

Exam: 100%.

Bibliographic references:

1. Allen J. Bard, « Electrochimie : principes, méthodes et applications », Masson, 1983.
2. Fabien Miomandre, Said Sadki, Pierre Audebert, « Electrochimie des concepts aux applications », Dunod, 2005.
3. B. Fremaux,« Eléments de cinétique et de catalyse, technique et documentation », Lavoisier.
4. G. Scacchi, M. Bouchy, J. F. Foucaut, O. Zahraa, R. Fournet, « Cinétique et catalyse », Lavoisier, 2011.
5. Genévrière ML Dumas, Roger Benaîm, l'indispensable en électrochimie, Breal, 2001.
6. J. Krabol, « Transfert de chaleur », Masson, 1990
7. Bird, Stewart, Lightfoot,« Transport phenomena », Second Edition, J. Wiley etSons, 2002.
8. Laszlo, « Les bases scientifiques du génie chimique », Dunod, 1972.
9. Robert E. Treybal, "Mass tranfer operation », Mc Graw-Hill, 1981.

Semester : *5*
Teaching Unit: MTU 3.1
Material 3 : Macroscopic assessments
SHV: 37h30 (Course: 1h30, Tutorials: 1h00)
Credits : 3
Coefficient : 2

Teaching objectives:

The various Process Engineering operations require the writing of material and energy balances to control the operation and sizing of equipment. The objectives of this subject are to provide all the fundamental concepts for carrying out the material and energy balances of a process in order to model the processes.

Recommended prior knowledge:

Physical chemistry, transfer phenomena, basics in math and computer science.

Material content:

- Fundamental concepts – black box analysis
- Processes with or without chemical reaction
- Determination of degrees of freedom
- Scheme with recycling
- Scheme with recycling and purging
- Examples of illustration (Continuous reactor; Separation column; Heat exchanger; Refrigeration tower; Boiler, etc.)

Evaluation method:

Continuous control 40%, Examination: 60%.

Bibliographic references:

1. P. C. Wankat, « Separation Process Engineering Includes Mass Transfer Analysis », Third edition, Prentice Hall publisher, 2011.
2. R. K. Sinnott, Coulson & Richardson'sChemical Engineering, Vol 6, Fourth edition, Elsevier publisher, 2005.
3. D. Ronze, » Introduction au génie des procédés », Editions Tec & Doc Lavoisier, 2008.
4. Joseph Lieto, « Le génie chimique à l'usage des chimistes », Tec & Doc (Editions), 2004.

Semester :*5*
Teaching Unit: DTU 3.1
Material 1: pharmaceutical processes
SHV: 22h30 (Course: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives:

Introduce in a descriptive manner the basic notions of the synthesis processes, treatment and purification of therapeutic molecules, their formatting in galenic formulations including the processes implemented, namely: Processes and technologies linked to the formulation and the industrial production of medicines.

Recommended prior knowledge:

Basics of Chemistry; Chemical engineering concepts.

Material content:

Chapter 1: The medicine (5 weeks)

•Introduction
• Definitions
• The stages of drug development
• Different classifications of drugs
• active ingredients
• Excipients
•The conditioning
• Drug activity and toxicity
• Become active ingredients in the body

Chapter 2: synthesis operations (3 weeks)

• Sources of active ingredients
• Methods for obtaining natural substances
• Synthetic methods
• Biotechnological methods

Chapter 3: Preformulation (3 weeks)

• Routes of administration
• Choice of dosage forms
• Biopharmaceutical classification (solubility, permeability)
• Dissociation coefficient, partition coefficient

Chapter 4: Manufacturing Environment (3 weeks)

•Pharmaceutical company
• Manufacturing of pharmaceutical water
•Air treatment
• Concept of quality in the pharmaceutical industry

Evaluation method:

Exam: 100%.

Bibliographic references:

1. K. Peter C. Vollhardt, Neil E. Schore, « Traité de chimie organique », 5ème édition, De boeck, 2009.
2. Graham L. Patrick, « Chimie pharmaceutique », De Boeck, 2002.
3. WEHRLE P. – PharmacieGalénique, Formulation et technologiepharmaceutique, janvier 2008. *MALOINE*
4. LE HIR A. – PharmacieGalénique, Bonnespratiques de fabrication des médicaments, 8ème édition, avril 2001. Abrégés chez MASSON

Semester 5
Teaching Unit: DTU 3.1
Material 2: Agro-food processes
SHV: 22h30 (Course: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives:

To introduce an important specialty of process engineering by presenting the notions of process engineering specific to this branch of economic activity. ; Briefly list the processes applied to the food industry.

Recommended prior knowledge:

Notions on separation techniques and transfer phenomena.

Material content:

Chapter 1: (2 weeks)
Transformation and preservation processes: Optimization of thermal processes: Pasteurization; Canning; Cooking ; Aseptic processes; Optimization of refrigeration processes, Refrigeration; Freezing; Refrigerated transport; Dehydration and combined processes: Drying; Smoking; Dehydration-impregnation by immersion (DII).

Chapter 2: (3 weeks)
General information on separation processes: Phase separation: Pressing; Decantation, Filtration; Centrifugation; Separation at the molecular level: Extraction; Distillation, Evaporation, Training...; Membrane processes.

Chapter 3: (4 weeks)
Reaction engineering: Physico-chemical reaction engineering: Coagulation, Gelation, Formation of mixed networks, Thermo-induced reactions, ; Biological reaction engineering: Biomass production, Metabolite production, Fermentation, Bioconversion.

Chapter 4: (3 weeks)
Structuring operation; Emulsification; Cooking-extrusion; Abundance.

Chapter 5: (3 weeks)
Mechanical and manufacturing operations: Grinding; Sieving; Flow (especially powders); Transfer ; Cutting ; Assembly and shaping; Packaging and packaging.

Evaluation method:

Exam: 100%.

Bibliographic references:

1. Laurent Bazinet, François Castaigne, « Concepts de génie alimentaire : Procédés associés et applications à la conservation des aliments », Tec & Doc, 2011.
2. Jean-Jacques Bimbenet, Albert Duquenoy, Gilles Trystram, « Génie des procédés alimentaires : Des bases aux applications », Dunod, 2007.

Semester :*5*
Teaching Unit: TTU 3.1
Material 1 : Pollution: Air, water, soil
SHV: 22h30 (Course: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives:

To discover the problems of pollution and management of our environment (causes, consequences, remedies, influences of the management of our environment); The "soil pollution" part is constructed in such a way as to be accessible without prior knowledge in soil sciences.

Recommended prior knowledge:

Basic knowledge of chemistry.

Material content:

Chapter 1: (5 weeks)

Water Pollution: Water cycle; Measurement of water quality; Sources, Mechanisms and symptoms of pollution of running waters and lakes; Influence of pollution on living beings; Oxygenation and deoxygenation; Eutrophication; Concepts on the treatment and purification of wastewater; Prevention of water pollution.

Chapter 2: (5 weeks)

Soil Pollution: Basics in soil sciences; Causes and consequences of soil degradation/pollution; Behavior of trace elements in the soil; Behavior of organic pollutants in the soil; Risk analysis and legislation; Decontamination techniques and case studies.

Chapter 3: (5 weeks)

Air Pollution: Scenario: Environment-Pollution-Sustainable Development-Energy-Primary energy consumption and CO2 emissions; Observation ; Fundamental notions of the atmosphere and meteorological parameters; Evolution of air quality and effect on organisms; Chemical components of atmospheric air; Chemical pollutants; NO2 pollution; Formation of pollutants; Some consequences of air pollution: Greenhouse effect; Photochemical smog; Ozone hole.

Evaluation method:

Exam: 100%.

Bibliographic references:

1. Olivier Atteia, « Chimie et pollutions des eaux souterraines », Ed. Lavoisier & Doc, 2015.
2. Emilian Koller, « Traitement des pollutions industrielles : Eau, air, déchets, sols, boues ».Ed. Dunod, 2009.
3. Françoise Nési,« La pollution des sols : Soil Pollution », 2010.
4. Louise Schriver-Mazzuoli,« La Pollution de l'air intérieur : Sources, Effets sanitaires, Ventilation », Ed. Dunod, 2009.

Semester :*6*
Teaching Unit: FTU 3.2.1
Material 1: Unitary operations
SHV: 67h30 (Course: 3h00, Tutorials: 1h30)
Credits : 6
Coefficient : 3

Teaching objectives:

Know the main unit operations and understand the process diagrams of the different process engineering industries (chemical, electrochemical, agri-food, pharmaceutical, etc.); Write and control the material balances of these processes.

Recommended prior knowledge:

Thermodynamics; Differential equations ; Transfer phenomena.

Material content:

Chapter 1: (1 week)
General information on unit operations: Absorption; Extraction; Adsorption; Distillation, etc.

Chapter 2: (3 weeks)
Absorption: Liquid-gas equilibrium; Isothermal absorption, Material balances; Theoretical floor concept; Mac Cabe and Thièle method, notions of contactors (packed and plate columns), hydrodynamics of flows

Chapter 3: (4 weeks)
Liquid – Liquid Extraction: Introduction; definition (solvent, solute, diluent), Balance diagram; Single stage extraction; multistage extraction: Mac Cabe and Thièle graphic method, number of theoretical plateaus

Chapter 4: (3 weeks)
Liquid-solid extraction (Leaching): Solid-liquid equilibrium; Janeck diagram: Determination of the number of theoretical stages, case of counter-current and cross-current extraction.

Chapter 5: (4 weeks)
Distillation: Distillation of a binary mixture; Distillation in batch, continuous mode; Calculation of the efficiency of a rectification column (Graphical methods of Mac Cabe and Thièle and Ponchon and Savarit).

Evaluation method:

Continuous control 40%, Examination: 60%.

Bibliographic references:

1. Robert E. Treybal,«Mass transfer operations», MC Graw Hill.
2. MC Cabe et Smith,« Chemical engineering operations», MC Graw Hill.
3. COULSON J.M., J.F RICHARDSON, J.R BACKHURST and J.H. HARKER, "Chemical Engineering", volume two, Fifth edition, 2002.

Semester :*6*
Teaching Unit: FTU 3.2.1
Material 2: Thermodynamics of equilibria
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives:

Master the application of the three principles of thermodynamics; Distinguish the different states of a gas; Predict the direction of the evolution of a chemical reaction.

Recommended prior knowledge:

Chemical thermodynamics; Differential equations.

Material content:

Chapter 1: Thermodynamics of solutions (2 weeks)

I.1 Behavior of a constituent in a mixture; I.2 Partial molar quantities; I.3 Excess quantities and activity; I.4 Models of non-electrolytic liquid solutions; I.5 Real gas mixtures and pseudo-critical properties

Chapter 2: Liquid-vapor equilibrium (5 weeks)

II.1 Equilibrium of an ideal binary mixture; II.2 Equilibrium of any solutions with miscible and immiscible constituents; II.3 Liquid-vapor diagram at constant pressure and temperature; II.4 Application to fractional and steam distillation; II.5 Extension to the ternary system

Chapter 3: Thermodynamics of liquid-liquid and liquid-solid equilibria (5 weeks)

III.1 Binary liquid-liquid mixture; III.2 Application to liquid-liquid extraction; III.3 Liquid-solid mixture; III.4 Diagram of activities and solubilities; III.5 Application to ternary mixtures;
III.6 Surfaces and Interfaces

Chapter 4: Thermodynamics of chemical equilibria (3 weeks)

IV.1 Equilibrium of a system in chemical reaction; IV.2 Homogeneous and heterogeneous chemical reactions; IV.3 Phase equilibria associated with a chemical reaction

Evaluation method:

Continuous control 40%, Examination: 60%.

Bibliographic references:

1. Smith, E.B, Basic, Chemical Thermodynamics, 2nd ed., Clarendon Press, Oxford, 1977.
2. Stanley I.Sandler, Chemical and Engineering Thermodynamics, Wiley, New York, 1977.
3. Lewis G.N., Randal M., Thermodynamics, Mac Graw Hill
4. Hougen O.A., Watson K.M., Chemical process principles, Vol II: Thermodynamics, John Wiley and sons
5. Brodyanski V., Sorin M., Le Goff P. The efficiency of industrial processes, exergy analysis and optimization, Amsterdam, Elsevier, (1994).
6. Wuithier, P, le pétrole, raffinage et génie chimique, édition technip 1972
7. Abbott M; Théorie et applications de la thermodynamique, série schum, Paris 1978
8. Kireev, V. Cours de chimie physique, Edition Mir, Moscou 1975

Semester :*6*
Teaching Unit: FTU 3.2.2
Material 1: Homogeneous reactors
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives:

Highlight the influence of the choice of chemical reactors and their operating conditions on the reaction products obtained. Sizing of ideal reactors.

Recommended prior knowledge:

Thermodynamics, basics of mathematics; transfer phenomena.

Material content:

Chapter 1: (1 week)

Stoichiometry: Concept of conversion rate; Concept of progress; Case of a single reaction; Case of several reactions.

Chapter 2: Classification of chemical reactors (1 week)

Classification of chemical reactors: Perfectly stirred batch reactor (R.D.P.A); Perfectly stirred stationary continuous reactor (R.C.P.A); Stationary tubular continuous plug flow reactor (R.C.P).

Chapter 3: Material balances in ideal reactors (2 weeks)

Single reaction: Closed, perfectly stirred reactor; Perfectly stirred reactor continuously in steady state; Piston reactor in steady state.

Chapter 4: Study of homogeneous isothermal chemical reactors with one reaction: (4 weeks)

1-R.D.P.A; R.C.P.A; R.C.P; 2- Association of chemical reactors: Association of stationary continuous reactors in plug flow (series/parallel); Continuous Reactor Association

perfectly agitated stationaries (series/parallel); 3- Comparative performances of ideal reactors.

Chapter 5: Study of homogeneous isothermal chemical reactors with several reactions (4 weeks)

Consecutive irreversible reactions; Competitive reactions. Selectivity and yield;

Chapter 6: Ideal non-isothermal reactors (3 weeks)

Notions of thermal balances in ideal non-isothermal reactors.

Evaluation method:

Continuous control 40%, Examination: 60%.

Bibliographic references:

1. O. Levespiel,«Chemical reaction engineering », Wiley,1972.
2. G.Antonini,Benaim,« Génie des réacteurs et des réactions ». Nancy 1991.
3. Trambouze,« Les réacteurs chimiques, Conception ».
4. J. Villermaux,« Génie de la réaction chimique, Conception et fonctionnement des réacteurs », Edition Technique et Documentation. 1982.
5. Froment GF Chemical reactor analysis and design 2nd edition (1990) J. Wiley
6. Schweich D. Génie de la réaction chimique. Tec&Doc Lavoisier, (2001) Paris

Semester :*6*
Teaching Unit: FTU 3.2.2
Material 2: Surface phenomena and heterogeneous catalysis
SHV: 45h00 (Course: 1h30, Tutorials: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives:

Make known the existence of surface tension as an essential parameter involved in interfacial interactions. Description of the phenomenon of gas adsorption on the surface of solids through the laws of thermodynamics. Application to the determination of the surface area and pore volume of solids.
Give the basics of heterogeneous catalysis and the different techniques for producing catalysts. Succinctly show the complexity of the catalytic act and the importance of modeling kinetics.

Recommended prior knowledge:

Mathematics ; Chemical kinetics; basics of thermodynamics.

Material content:

Chapter 1: (3 weeks)
Liquid-gas interface, Surface tension: Concept of surface tension; Thermodynamic functions; Effect of temperature; Effect of concentration; Gibbs relationship; Measurement of molecular area; Physico-chemical study of surfactant: Adhesion and cohesion; Wetting and contact angle.

Chapter 2: (5 weeks)
Adsorption of gases at the solid-gas interface: Types of adsorption; Thermodynamic study; Heat of adsorption; Physisorption equilibria: adsorption in monolayer (modeling), in multilayers (modeling); Application to the determination of the surface area of a solid. Hysteresis phenomena: Porosity; Kelvin's law; Porous volume.

Chapter 3: (2 weeks)
Gas chemisorption equilibria: chemisorption isotherms. Langmuir, Temkin, and Freundlich models.

Chapter 4: (2 weeks)
Introduction and general information on catalysts: Preparation methods; Characterization ; Classification.

Chapter 5: (3 weeks)
Kinetics of reactions in heterogeneous catalysis: Mechanisms and models

Evaluation method:

Continuous control 40%, Examination: 60%.

Bibliographic references:

1. C. E. Chitour,«Physico-chimie des surfaces », OPU. Volume 1 et 2.
2. J.M. Coulson, J.F. Richardson, Backhurst, Harker,« Chemical engineering », Pergamon Press.
3. J. Fripiat, J. Chaussidon, A. Jelli, « Chimie-physique des phénomènes de surface », Masson.
4. M. Boudart,« Cinétique des réactions en catalyse hétérogène »,Masson.

5. Fauvelle. J.L. (1989). La physico-chimie; son rôle dans les phénomènes naturels, astronomiques, géologiques, et biologiques. Édition : *Reinwald*, 512 p.
6. Friedli, C. (2005). Chimie générale pour ingénieur, Édition : *Presses polytechniques et universitaires romandes*.750p.
7. Fripiat, J. Chaussidon J, Jelli A. (1971) Chimie-physique des phénomènes de surface, Édition : *Masson*, 387 p.
8. Landolt, D. (1993) Corrosion et chimie de surfaces des métaux. Édition : *PPUR presses polytechniques.* 552 p.
9. Lalauze, R. (2006). Physico-chimie des interfaces solide-gaz 1 : concepts et méthodologie pour l'étude des interactions solide-gaz (Coll. Capteurs et instrumentation). Édition *Hermes Science*, 240 p.
10. Somorjai, G.A., Marie-Paule Delplancke, M.P. (1995). Chimie des surfaces et catalyse Édition : *Ediscience International.* 713 p.
11. Peter William Atkins, Julio De Paula, Chimie Physique, Editeur : De Boeck, 4e édition , 2013
12.Sidney F.A. Kettle, Physico-chimie inorganique, Editeur : De Boeck, 4e édition , 2013
13. Moore W.J.Chimie physique .Ed Dunod , 2 éme Edition (1965)

Semester :*6*
Teaching Unit: MTU 3.2
Material 1: End of Cycle Project
SHV: 45h00 (PW: 3h00)
Credits : 4
Coefficient : 2

Teaching objectives:

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

Recommended prior knowledge:

The entire Bachelor's program.

Material content:

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

Noticed :

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

At the end of this study, the student must submit a written report in which he must explain as explicitly as possible:
- Detailed presentation of the study theme, emphasizing its interest in its socio-economic environment.
- Means implemented: methodological tools, bibliographical references, contacts with professionals, etc.
- Analysis of the results obtained and their comparison with the initial objectives.
- Critique of the discrepancies observed and possible presentation of other additional details.
- Identification of the difficulties encountered by highlighting the limits of the work carried out and the follow-up to be given to the work carried out.

The student or group of students finally presents their work (in the form of a brief oral presentation or on a poster) in front of their tutor teacher and an examining teacher who can ask questions and thus evaluate the work accomplished on the plan. technical and that of the presentation.

Evaluation method:

Continuous control: 100%

Semester :*6*
Teaching Unit: MTU 3.2
Material 2: Process simulators
SHV: 37h30 (Course : 1h30, PW: 1h30)
Credits : 3
Coefficient : 2

Teaching objectives:

- Become familiar with the concepts of process modeling and simulation.
- Know the main simulation software in process engineering.
- Learn the basics of equipment and process design using software.

Recommended prior knowledge:

Mathematics. Physical chemistry. Notions of transfer phenomena.

Material content:

Chapter 1: (2 weeks)
General: Definition of simulation; Mathematical modeling; Commercial simulators (HYSYS, Aspen, Prosim, etc.); Constituent elements of a process simulator; presentation of the chosen software.

Chapter 2: (3 weeks)
Start with the chosen Software: Creation of a simulation; Selection of the list of compounds; Selection of the thermodynamic model; Become familiar with the simulation sheet; Installation and specification of material flows.

Chapter 3: (3 weeks)
Thermodynamic models of the chosen Software: Equations of state; Prediction of physical properties of pure substances and mixtures; Calculation of liquid-vapor equilibria.

Chapter 4: (3 weeks)
Simulation of some equipment: Simulation of pumps; Compressors; Regulators; Flash separator; Heat exchanger ; Furnaces and reactors.

Chapter 5: (4 weeks)
Examples of process simulation

Evaluation method:

Continuous control 40%, Examination: 60%

Bibliographic references:

1. Michael E. Hanyark Jr.,«Chemical Process Simulation and the Aspen HYSYS Software », CreateSpace Independent Publishing Platform, 2012.
2. Hossein Ghanadzadeh Gilani, Katia Ghanadzadeh Samper, Reza Khodaparast Haghi, « Advanced Process Control and Simulation for Chemical Engineers », CRC Press, 2012.
3. Alexandre Dimian, « Integrated Design and Simulation of Chemical Processes », Elsevier, 2003.
4. Amiya K. Jana, « Chemical Process Modeling& Computer Simulation », PHI Learning Pvt. Ltd., 2008.

Semester :*6*
Teaching Unit: MTU 3.2
Material3: Chemistry Physics2 and Chemical Engineering 2 Lab
SHV: 22h30 (TP: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives:

Observation of physical phenomena studied during lectures; Validate and correctly present the results obtained; Formulate and communicate conclusions.

Recommended prior knowledge:

Notions of kinetics, basics of thermodynamics, Being informed of safety instructions in a laboratory and being willing to work in a group.

NB: List for information only, adapt according to means.
Number of practical exercises to complete = eight (8): 2 in Thermodynamics; 2 in surface chemistry; 4 in Chemical Engineering.

Material content:

TP1. Thermodynamics
-Determination of the heat of dissolution.
-Thermodynamic functions of an acid – base equilibrium.
-Heat of vaporization of a pure liquid (Determination of the latent heat of vaporization of acetone.)
-Thermodynamic phase diagrams: Liquid-vapor equilibria. Liquid-liquid equilibria.
-Ionic reaction heat.
-Determination of partial molar volumes of a binary solution.
-Diagram of a ternary mixture.

TP2. Surface phenomena
-Adsorption of a dye (methylene blue) on an adsorbent material (CA).
-Adsorption of an organic compound (acetic acid/phenol) on activated carbon
-Measurement of surface tension.

TP3. Chemical engineering
-Discontinuous distillation.
-Continuous distillation of the Ethanol/Water mixture.
-Simple distillation
-Solvent extraction
-Sharing coefficient

Evaluation method:

Continuous control: 100%.

Semester :*6*
Teaching Unit: DTU 3.2
Material1 : Cryogenic processesSHV:
22h30 (Course: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives:

Present the different processes in the field of cold and cryogenics; Some applications in the field of low temperatures.

Recommended prior knowledge:

Heat transfer phenomena; Thermodynamics and mathematical tools (differential equations and integral calculus).

Material content:

General introduction: Cryogenics and its fields of application (1 week) Chapter 1: (2 weeks)
Vacuum technology: Importance of vacuum in cryogenics; Vacuum production systems.

Chapter 2: (4 weeks)
Processes for separating and purifying cryogenic fluids: Separation process: ideal system; Separation processes – Rectification; Role and description of the Joule Thomson valve; Air separation processes.
Chapter 3: (5 weeks)
Permanent gas liquefaction processes: Linde-Hampson liquefaction process; Linde-Hampson double compression liquefaction process; Claude's liquefaction process.

Chapter 4: (3 weeks)
Cryogenic applications: Discovery of superconductivity; Application in the food industry.

Evaluation method:

Exam: 100%.

Bibliographic references:

1. R.F. BARRON, « Cryogenic Systems », 2nd Edition, Oxford University Press, NY, 1985.
2. PETIT, « Oxygène, Azote, Gaz Rares De l'Air », Techniques De l'Ingénieur, Traité Génie Et Procédés Chimiques, J 6020,1973.
3. F.Ayela, P. Decool, J.L.Duchateau, P.Gandit, F.Kircher, A.Sulpice,L.Zani, « Températures Cryogéniques Et Fluides », Techniques De l'Ingénieur, R2811, 2004.
4. A. Rojey, B. Durand, C. Jaffret, S. Jullian et M. Valais, « Le gaz naturel », Ed. Technip, 1994.
5. P. Wuittier, Tome II, « Raffinage et génie chimique », Edition Technique, France 1972.
6. Engineering Data Book, « Physical properties », Section 23, Edition1994.
7. R.C. Reid, J. M. Prausnitz, T. K. Sherwood, « The Properties of gases and liquids », Third Edition Mc. Graw Hill 1977.
8. K.D. Timmerhaus, T.M. Flynn « cryogenic process engineering « Springer Science + business media, LLC 1989.

Semester :*6*
Teaching Unit: DTU 3.2
Material 2 : Corrosion
SHV: 22h30 (Cours: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives:

Make the phenomenon of corrosion known: Give the theoretical bases, and present the different techniques for protection against corrosion.

Recommended prior knowledge:

The basics of electrochemistry, surface phenomena.

Material content:

Chapter 1: (6 weeks)

Different types of corrosion: Electrochemical corrosion: Generalized corrosion (uniform and galvanic); Localized corrosion; Stress corrosion; Intergranular corrosion, etc. ; Chemical corrosion; Bacterial corrosion.

Chapter 2: (3 weeks)

Phase diagrams: Potential-pH diagram, Applications

Chapter 3: (6 weeks)

Different means of protection: Coatings; Inhibitors; Cathodic protection.

Evaluation method:

Exam: 100%.

Bibliographic references:

1. Dieter Landolt, « Corrosion et chimie de surfaces des métaux» , traité des Matériaux, processus polytechnique et universitaires, Romandes, 1997.
2. C.Rochaix, « Electrochimie thermodynamique- cinétique », Edition Nathan, 1996.
3. B.Baroux, « La corrosion des métaux; passivité et corrosion localisée », Dunod, 2014.
4. G.Béranger, H.Mazille, « Corrosion des métaux et alliages: mécanismes et phénomènes »; Traité MIM, série Alliage métalliques, Lavoisier, 2002.
5. F.Ropital, « Corrosion et dégradation des matériaux métalliques », Ed. Technip, 2009.

Semester: 6
Teaching Unit: UET 3.2
Matière 1: Professional project and business management
SHV: 22h30 (Cours: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

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

Content of the material:

Chapter 1: Business and society (3 weeks)

The company: Definition and objectives of the company. Different business forms, company structure, personnel and company partners.
Different types of business (VSE, SME, SMI, ETI, GE)
The company: Definition and objectives of the company
Different types of company (SARL, EURL, SPA, SNC,)
Difference between business and society.

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

Method of organization and operation of the company
The main functions of the company (production company, service company, etc.) Structure of the company (definition and characteristics)
Different types of structures (functional, divisional, multidivisional, hierarchical-functional "staff and line" structure).
Additional activities of the company (partnership, subcontracting, etc.).

Chapter 3: How to enter a company (3 weeks)

Personnel needs and quality (senior executives, managers, technicians, workers, etc.)
Where to find the job offer? (ANEM, section, internet, etc.) How to go about it? (the application, the CV)
The different types of job interviews and how to go about it. Types of employment contract (CDI and CDD)
Salary (how to calculate a pay slip).

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

The journey of the business creator (the idea, capital, financial assistance, etc.) How to find a good idea?
Financial aid schemes for investment (ANSEJ, CNAC, ANDI, ANGEM, PNR)

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

Studying a business creation project requires the promoter to make the effort to plan and write in detail the phases and steps he will have to take to get his business off the ground.
Market study (sales department, marketing, etc.).

Technical study (location, equipment and machine requirements, production capacity, etc.).

Financial study (turnover, salary costs, expenses and consumption, taxes, etc.).

Mini project for the study of a business creation project.

Evaluation mode:

100% exam

Bibliographic references

1. -Antoine Melo '' Gestion d'entreprise'' édition Melo France 2016
2. -Thomas Durand '' Management d'entreprise'' édition Broché 2016
3. -Philippe Guillermic '' La gestion d'entreprise pas à pas '' édition Poche 2015
4. -Guy Raimbault ''Outils de gestion'' édition Chihab Alger 1994
5. -Institut de technologie financière '' Initiation comptable ''OPU Alger 1993
6. -Christian Bultez ''Guide et mode d'emploi des démarches '' édition Nathan Paris 1993

IV - Agreements/Conventions

STANDARD LETTER OF INTENT

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

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

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

Par la présente, l'université (ou le centre universitaire) declares to co-sponsor the license mentioned above throughout the License authorization period.
To this end, the university (or university center) will assist this project by:
- Giving his point of view in the development and updating of teaching programs,
- Participating in seminars organized for this purpose,
- By participating in defense juries,
- By working to pool human and material resources

SIGNATURE of the legally authorized person:

FUNCTION:

Date :

STANDARD LETTER OF INTENT

(If licensed in collaboration with a user sector company)
(Official company letterhead)

SUBJECT: Approval of the project to launch a License course entitled:

Provided to:

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

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

- Give our point of view in the development and updating of teaching programs,
- Participate in seminars organized for this purpose,
- Participate in defense juries,
- Facilitate as much as possible the reception of interns either as part of end-of-study dissertations or as part of tutored projects.

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

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

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

OFFICIAL STAMP or COMPANY SEAL

V- Opinions and Visas from Administrative and Consultative Bodies

Title of the Degree: Process Engineering

Head of department + Head of the domain team
Date and visa: **Date and visa:**
Dean of the faculty (or Institute Director)
Date and visa :
Head of university establishment
Date and visa:

VI – Notice and Visa of the Regional Conference

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