"Democratic and Popular Republic of Algeria Ministry of Higher Education and Scientific Research"
Khemis Miliana University

COURSE OFFERING L.M.D.

ACADEMIC Bachelorof science

NATIONAL PROGRAM 2021-2022 (2nd update)

Establishment	Faculty / Institute	Department

field	Stream	Speciality
Sciences and Technologies	***Process engineering***	***Process engineering***

عرض تكوين
ل. م . د
ليسانس أكاديمية

برنامج وطني
2021 - 2022

المؤسسة	الكلية/ المعهد	القسم

الميدان	الفرع	التخصص
علوم و تكنولوجيا	هندسة الطرائق	هندسة الطرائق

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I – Identity card of the Bachelor's degree

1- Course Location:

Faculty (or Institute):

Department:

References of the accreditation decree of the degree program (attach a copy of the decree)

2- External Partners:

Other partner institutions:

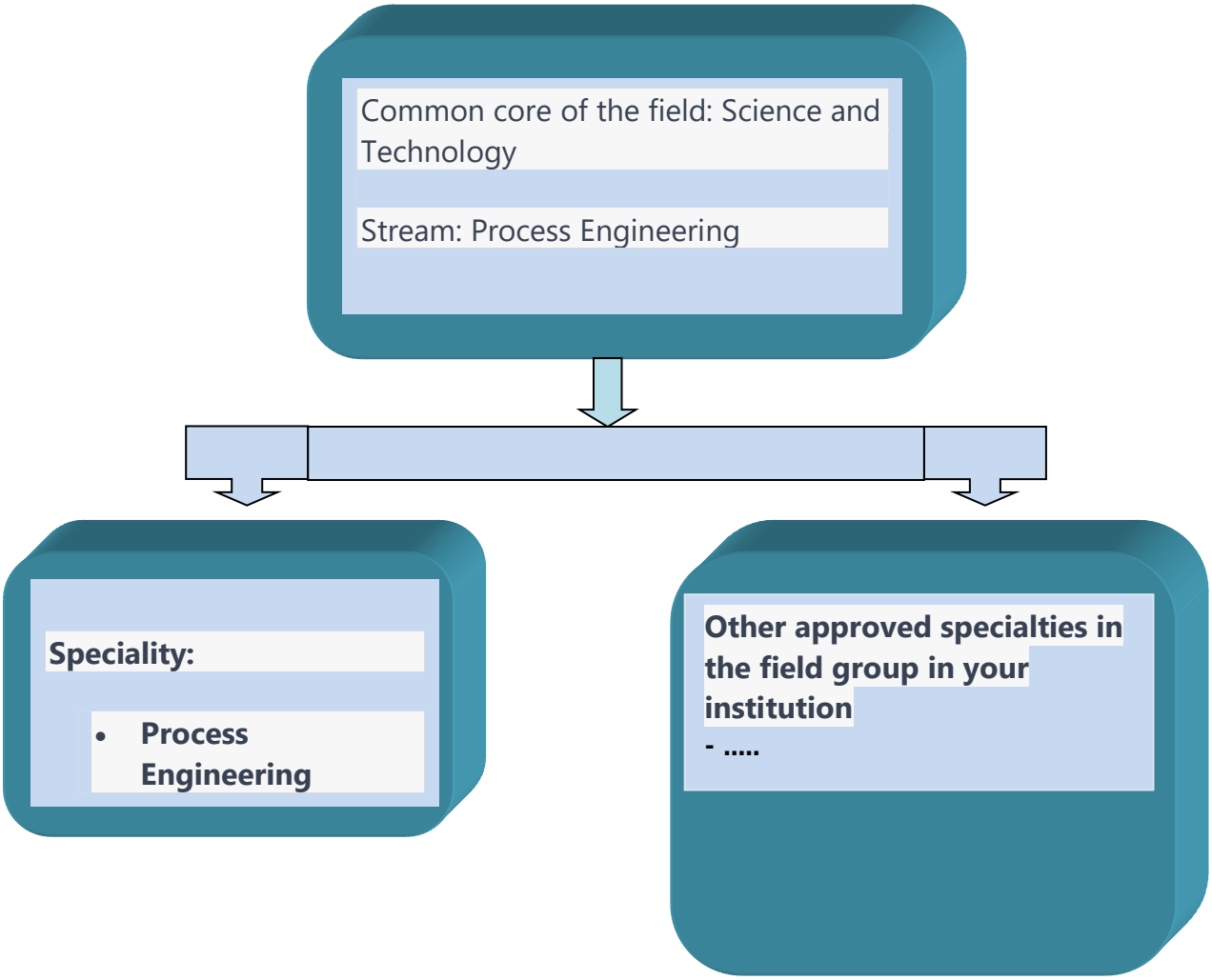
Companies and other socio-economic partners:

International partners:

3 - Context and Objectives of the course

A - General organization of the course: project position

Include in the following diagram the Bachelor's degree covered by this outline as well as all approved licenses (functional or non-functional) at the institution level and belonging to the same Group of disciplines. Specify by an asterisk any other license whose supervision is also provided by a good number of teachers involved in this present license. Indicate frozen licenses by a double asterisk. Also mark (P) any professionalizing type of license.



B - CourseObjectives:

Process Engineering is an important field in the science and technology (ST) domain. This field, which initially revolved around fundamental chemical engineering, now includes a wide range of specialties such as Chemical Engineering, Environmental Engineering, Materials Engineering, Pharmaceutical Engineering, Electrochemical Engineering, Cryogenics, Energy, and Agro-Food Processing.

Process Engineering plays a vital role in all industrial processes that involve the transformation of matter and energy. Therefore, it is essential to train individuals capable of mastering industrial-scale transformation processes. This undergraduate degree program includes fundamental subjects of the field such as physical chemistry, unit operations, transfer phenomena, reactors, etc. and serves as a basic training for all specialties of Process Engineering.

Upon completion of this interdisciplinary program, graduates will have acquired basic knowledge not only in fundamental sciences such as mathematics, physics, and chemistry but also in technology and industrial processes such as reactors, processes, transfer phenomena, instrumentation, industrial facilities, etc. necessary for understanding Process Engineering and its various applications.

This degree program enables graduates to pursue advanced studies in various specialized masters' programs and to quickly integrate into the socio-economic sector.

The general nature of this undergraduate program provides a basic education in the field and allows access to specialized master's programs in various options such as Chemical Engineering, Environmental Engineering, Pharmaceutical Engineering, Water Treatment, Electrochemical Engineering, Polymer Engineering, Cryogenics, etc. which aim to reinforce the basic concepts of Process Engineering.

Upon completion of the third year (L3), graduates will have acquired sufficient theoretical and practical knowledge (knowledge and skills) to assimilate any process of material transformation. They are capable of establishing material transformation balances, sizing and controlling equipment, and performing measurements in a production and treatment chain.

The acquired competencies enable graduates to integrate into various industrial sectors such as chemical, pharmaceutical, electrochemical, agro-food, material, cosmetic, water treatment, environmental protection, etc., and satisfy the country's need for technical professionals

C – Profiles and targeted skills

The general nature of the degree provides a basic education in the field that allows access to specialized master's programs in different options such as Chemical Engineering, Environmental Engineering, Pharmaceutical Engineering, Water Treatment, Electrochemical Engineering, Polymer Engineering, Cryogenics, etc. These programs aim to strengthen the basic concepts of process engineering. Upon completion of the third year (L3), graduates have acquired sufficient theoretical and practical knowledge (knowledge and know-how) that enable them to assimilate any process of material transformation. They are able to establish balances of a transformation, dimension and control equipment, and carry out measurements in a production and treatment chain. The skills acquired allow graduates to integrate into different industrial sectors such as chemical, pharmaceutical, electrochemical, agro-food, materials, cosmetics, water treatment, environmental protection, etc., and to meet the country's needs for technical professionals. D – Potentialités régionales et nationales d'employabilité: Le Génie des Procédés traite de l'industrialisation de la chimie et des procédés de transformation et de purification de la matière. Les domaines d'application se succèdent tout au long de la mise au point du procédé de fabrication : développement au laboratoire, échelle pilote, dimensionnement des appareillages, construction de l'unité puis son exploitation. Ce parcours en génie des procédés vise à former des cadres polyvalents avec un savoir et un savoir-faire qui leur permettent de s'insérer à tous les niveaux du processus. Ils sont destinés à occuper des postes de Chargé d'Etudes, Chargé de Projet, Technicien de process, etc. Ce parcours cible les grandes entreprises exerçant dans les domaines des procédés, de la chimie, de l'énergie et de l'environnement à l'échelle nationale, comme par exemple Sonatrach, Sonelgaz, ADE, les cimenteries, Saidal, etc. A l'échelle régionale, Il y a également un fort potentiel de débouchés au niveau du tissu des PME-PMI ayant des activités de bureaux d'études, de cabinets d'expertise, de transformation de matière et de traitement. Avec le cursus proposé dans le cadre de cette licence, les diplômés sont capables d'intégrer différents secteurs socio-économiques : ⎫ Enseignement technique dans le secondaire ; ⎫ Les laboratoires de recherche ; ⎫ Les organismes publics ; ⎫ Les bureaux d'études ; ⎫ Le secteur industriel. Pour ce dernier secteur, ces diplômés constituent la colonne vertébrale de l'encadrement dans les unités de productions (Industries Chimiques,Pétrochimie, Raffinage, Cimenterie, Traitement des Eaux,Technologie de fabrication des médicaments,Agroalimentaire, etc.)

E – Bridges to other Specialities:

Commun Semester 1 and 2	
Stream	**Specialities**
Aerospace engineering	Aerospace engineering
Civil engineering	Civil engineering
climate engineering	Climate engineering
Marine engineering	Naval Propulsion and Hydrodynamics
	Naval Construction and Architecture
Mechanical engineering	Energetics
	Mechanical Construction
	Materials Engineering
Hydraulics	Hydraulics
Transportation engineering	Transportation Engineering
Metallurgy	Metallurgy
Optics and mechanics of precision	Optics and Photonics
	PrecisionMechanics
Public works	Public Works
Automation engineering	Automation
Electromechanics	Electromechanics
	Industrial Maintenance
Electronics	Electronics
Electrical engineering	Electrical Engineering
Biomedical engineering	Biomedical Engineering
Industrial engineering	Industrial Engineering
Telecommunication engineering	Telecommunications
Process engineering	Process Engineering
Mining engineering	Mining Operations
	Mineral Resource Development
Petroleum engineering	Hydrocarbons
Industrial hygiene and safety	Hygiene and industrialSafety
Petrochemical industries	Refining and Petrochemicals

Table of fields and specialties in the Science and Technology domain

Group of fields A Common Semester 3	
Field	Specialties
Control engineering (Automatics)	**Control engineering** (Automatics)
Electromechanics	**Electromechanics**
	Industrial maintenance
Electronics	**Electronics**
Electrical engineering (Electrotechnics)	**Electrical engineering**(Electrotechnics)
Biomedical engineering	**Biomedical engineering**
Industrial engineering	**Industrial engineering**
Telecommunications	Telecommunications

Group of fields B Common Semester 3	
Field Filière	Specialties
Aeronautics	**Aeronautics**
Civil engineering	**Civil engineering**
Climate engineering	**Climate engineering**
Maritime engineering	**Naval propulsion and hydrodynamics**
	Naval architecture and construction
Mechanical engineering	**Energetics**
	Mechanical construction
	Materials engineering
Hydraulics	**Hydraulics**
Transport engineering	**Transport engineering**
Metallurgy	**Metallurgy**
Optics and precisionmechanics	**Optics and photonics**
	Precisionmechanics
Public works	**Public works**

Group of fields C Common Semester 3	
Field	Specialties
Process engineering	**Process engineering**
Mining engineering	**Mining exploitation**
	Mineralresourcesvalorization
Hydrocarbons	**Hydrocarbons**

Industrialhygiene and safety	**Industrialhygiene and safety**
Petrochemical industries	**Refining and petrochemistry**

The programs that have common basic teachings among them (semester 3) have been grouped into three groups: A, B, and C. These groups roughly correspond 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 interdisciplinary and cross-disciplinary teaching programs: Interdisciplinary in the sense that the teachings in this specialty are identical 100% for semesters 1 and 2 with all specialties in the Sciences and Technologies field. Moreover, the teachings for semester 3 for all specialties in the same group of programs are also identical 100%.

Semester	Groupe of stream	Communteaching
Semester 1	A - B – C	(30 / 30) Credits
Semester 2	A - B – C	(30 / 30) Credits
Semester 3	A – B	(18 / 30) Credits
	A – C	(18 / 30) Credits
	B – C	(24 / 30) Credits

In a transversal way, this Bachelor's degree offers students the choice to join, if they express the desire and depending on the available educational places:

- All other specialties in the field of Science and Technology (ST) at the end of the second semester.
- All specialties in the same group of programs at the end of the third semester.
- All specialties in a different group of programs at the end of the third semester (subject to equivalence conditions and the opinion of the training team).
- All specialties in the same group of programs at the end of the fourth semester (subject to equivalence conditions and the opinion of the training team).

F – Expected performance indicators for the training:

Any training should meet the quality requirements of today and tomorrow. To better assess the expected performance of the proposed training and to take advantage of the flexibility and adaptability of the LMD system, a number of mechanisms are suggested for this degree program to evaluate and monitor the progress of teaching, the curriculum, the student/teacher and student/administration relationships, the career paths of graduates of this program, as well as feedback from university partners on the quality of graduates recruited and/or the teaching provided. It is up to the training team to enrich this list with other criteria based on its own resources and objectives.

Evaluation methods can be implemented through surveys, monitoring of students during their training, and surveys of recruited graduates and their employers. For this purpose, a report must be established, archived and widely disseminated.

1. Evaluation of the training process:

In addition to regular meetings of the academic committee, a meeting is held at the end of each semester, bringing together teachers and students to discuss any problems encountered, possible improvements to teaching methods in particular, and the overall quality of the program.

To this end, the following list provides an exhaustive or more or less exhaustive list of the indicators and methods envisaged for the evaluation and monitoring of this training project by the academic committee:

Prior to training:

⎪ Evolution of the rate of students choosing this degree program (supply/demand ratio). ⎪ Rate and quality of students who choose this degree program.

During training:

⎪ Regular meetings of academic committees. ⎪ Conformity of the subjects of end-of-cycle projects with the nature of the program. ⎪ Quality of the relationship between students and the administration. ⎪ Support provided to students in difficulty. ⎪ Student satisfaction rates with teaching and teaching methods.

After training:

⎪ Success rate of students per semester in this degree program. ⎪ Dropout rate (failures and withdrawals) of students. ⎪ Identification of the causes of student failure. ⎪ Alternatives for reorientation are proposed to students in the event of failure. ⎪ Percentage of students who obtain their degrees on time. ⎪ Percentage of students who continue their studies after graduation.

2. Evaluation of teaching:

The courses in this program are regularly evaluated (once a year) by the training team, which will be made available to various institutions upon request: National Pedagogical Committee of the Science and Technology Domain, Regional Conferences, Vice-Rectorate in charge of Pedagogy, Faculty, etc.

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

⁾ Equipment of classrooms and educational laboratories with the necessary equipment and supports for pedagogical improvement (projection systems (data shows), wifi connection, etc.). ⁾ Existence of a communication and teaching platform in which lectures, tutorials, and practical sessions are accessible to students and their questions resolved. ⁾ Equipment of educational laboratories with materials and equipment that are in line with the content of the courses. ⁾ Number of effective teaching weeks during a semester and student absenteeism rates. ⁾ Completion rate of teaching programs. ⁾ Digitalization and preservation of end-of-study and/or end-of-cycle projects. ⁾ Number of practical sessions carried out as well as the multiplication of the type of practical sessions by subject (diversity of practical sessions). ⁾ Quality of the institution's documentary resources in relation to the specialty and its accessibility. ⁾ Support from the socio-economic sector for training (company visits, internships in companies, courses and seminars given by professionals, etc.)

3Insertion of graduates:

A coordination committee is created, composed of training managers and administrative members, which is primarily responsible for monitoring the integration of graduates from the field into professional life, creating a tracking file of graduates from the field, identifying and/or updating existing economic and industrial potential at the regional and national levels, anticipating and promoting new jobs related to the field in partnership with the chamber of commerce, various employment support agencies, public and private operators, etc., and participating in any action related to the professional integration of graduates (organizing events with socio-economic operators). To carry out these tasks, this committee has full latitude to conduct or commission any study or survey on the employment and post-employment of graduates. Below is a list of indicators and methods that could be considered to evaluate and monitor this operation:

⁾ Recruitment rate of graduates in the socio-economic sector in a position directly related to the training. ⁾ Nature of the jobs held by graduates. ⁾ Diversity of career opportunities. ⁾ Establishment of an association of former graduates from the field. ⁾ Creation of small businesses by graduates of the specialty. ⁾ Degree of employer satisfaction.

G- Evaluation of the student through Continuous Assessment and Personal Work:

G1- Evaluation through Continuous Assessment:

The importance of the methods of continuous assessment on the students' training in terms of educational achievements is no longer to be demonstrated. In this regard, articles 20, 21 and 22 of decree 712 of November 3, 2011, define and specify the methods and organization of the continuous assessment of students according to the training course. The calculation of the averages of continuous assessment (directed work and practical

work) is based on a weighting of all the elements that make up this evaluation. These articles specify that this weighting is left to the discretion of the pedagogical team.

A survey conducted by the NPCD-ST among all teachers in various universities showed heterogeneity in the implementation of continuous evaluation of students. Therefore, we are led to admit a real deficit in the effective handling of this pedagogical activity, which has required serious reflection on our part combined with proposals from several institutions, resulting in the recommendations below

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

1. Proposals related to subjects with directed work:

1.1. Preparation of exercise series:

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

Each end of a series of exercises (i.e. each end of a chapter) will be sanctioned by a short written test. This test must be organized in collaboration with the subject responsible to ensure fair evaluation for all students (especially when several teachers intervene in directed work).

1.3. Student participation in directed work:

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

1.4. Student attendance:

Student attendance is mandatory in TD and TP. In lectures, it is difficult to control for undergraduate students, where the numbers are very large (lectures in amphitheaters). For master's students where the numbers are reduced, attendance must be mandatory in lectures and TD.

2. Case of methodological units (Practical work):

Like TD, TP must be prepared by the student. A test to control this preparation must be organized by the teacher before each manipulation (in the form of small comprehension questions, multiple-choice questions, a diagram of the manipulation, etc.). A report (per work group) must be submitted at the end of the practical work session. To this end, the teacher must prepare a report template (framework) to facilitate the work for the students so that they can actually submit it at the end of the TP session. At the end of the semester, the teacher organizes a TP test that summarizes all the manipulations carried out by the student.

3. About transversal and discovery subjects that do not have TD or TP:

It is very difficult to perform continuous controls in these subjects due to the absence of directed work sessions and the very large number of students in most cases, particularly for universities with very high enrollment. However, the teacher in charge of this subject can, if desired, let students know that they may be evaluated (continuously) by proposing to prepare presentations, writing reports, researching complementary materials, exploiting free software, asking students to watch a popular science film related to the subject (after giving them either the film on electronic media or indicating the internet link to the film) and then asking them to submit a written report or to make an oral presentation of the summary of this film, etc. The bonus for these activities is left to the discretion of the teacher and the training team, who are the only ones able to define the best way to take these personal work into account in the final exam grade.

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 subject's responsible teacher may consider continuous evaluations of the student, similar to what is done in subjects with directed work. The only obligation to respect is that students should be informed of this procedure and validated during the first pedagogical council.

4. Harmonization of continuous assessment:

The use of a common grid for evaluation would promote harmonization of these practices from one teacher to another, from one department to another, and from one institution to another. It would also be a structuring and reassuring reference for students. To do so, we propose below an indicative evaluation grid that presents the different continuous assessments allowing the evaluation of the degree of acquisition of students' competencies, whether in terms of knowledge, analytical skills, or synthesis skills.

Note that these evaluations are not intended to "trap" students by imposing very difficult continuous assessments. On the contrary, it is about "honestly" assessing the degree of assimilation of the various competencies and knowledge taught to the student in all

objectivity. In the same spirit, we would gain by favoring the contractualization of the evaluation of learning by specifying, for example, the success criteria and good practices that would lead to correct and precise answers to questions. Thus, the evaluation would mainly focus on the skills that have been taught, giving exercises related to what has been prepared in the tutorial sessions without forgetting, however, to assess students' ability to mobilize their skills in more complex situations.

4-1 Tutorial Sessions (TD):

Preparation of exercise sets and personal work (assignments, presentations, etc.)	30%	06 points
Written tests (at least 2 tests, one of whichisproposed by the course coordinator)	50%	10 points
Participation of students in TD sesssions.	20%	04 points
Total	**100%**	**20 points**

4.2 Practical Woks (PW/Lab/TP) :

Preparation tests for practical work:.	20%	04 points
Report (to be submitted 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- Personal work by the student:

Personal work by the student is a key element of the LMD system. A very significant amount of time has been allocated for this purpose, approximately 50% of the total training hours (see the "Summary of the program" table in this training offer). A survey conducted by the CPND-ST among training teams in all university institutions revealed that the time devoted to personal work by students could be effectively utilized, under the guidance of the teacher, in a rational and varied manner. Tasks accomplished by willing students would be evaluated and counted (as a bonus) towards their overall grade in the continuous assessment. The rate of this bonus is left to the discretion of the teaching teams.

The synthesis of the various proposals can be summarized as follows:

1. Homework:

In order to enrich the knowledge and strengthen the training of students, they will be required to complete additional homework guided by their course or tutorial teachers. This type of work may include, for example, encouraging students to research specific and/or conflicting questions raised during class, solving a difficult exercise, providing a detailed proof of a theorem, researching supplementary materials related to the course, using free software or CAD-CAM tools to make applications and simulations related to the course, etc. These activities can be evaluated, graded, and recorded as a bonus for students who complete them.

2. Mini course project:

The mini course project (1 to 3 weeks) is an effective way to prepare students for the methodology of expression, writing, and documentary research. It is a means for them to concretize through practice the techniques learned in cross-curricular subjects. It also allows them to develop a spirit of teamwork.

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

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3. Report on a visit, an educational outing, or a discovery and/or immersion internship:

Visits, educational outings, discovery and/or immersion internships are opportunities for students to better understand the reality of the working world and help them to better integrate into their future careers. Administrative staff and teachers should encourage, as much as possible, this very important aspect of education and ensure the organization of visits and educational outings throughout the training program.

They should also help/encourage students to prospect economic institutions in order to find (in L3 and M1) discovery and/or immersion internships lasting one to two weeks in the industrial sector during winter and spring breaks. In this context, teachers must ensure that students take notes during these outings and require reports (several pages long). 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 reports effectively.

Regenerate response

4. Participation in scientific events:

In order to instill a scientific mindset in students (especially those at the higher education level), they should be directed and encouraged to participate in roundtables, laboratory seminars, and conferences organized within their faculty and/or institution. It is even recommended to encourage these students to attend conferences related to their field of

study outside of their university, such as exhibitions, fairs, and other events. This activity can be evaluated, graded, and credited as a bonus to the student who participates.

5. Use of New Information and Communication Technologies:

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

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Conclusion :

The autonomy of the student, considered as a lever for success, relies largely on the personal work that the student is required to do, by appropriating the resources and tools made available to them. Of course, all of this must be supervised and formalized within the framework of the educational monitoring and support that must be provided jointly by the university teacher and the administrative supervisor throughout the student's training course.

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

4 -Available Human Resources: A: Supervision capacity (expressed in the number of students that can be accommodated):

Number of students:

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

Noun and pronoun	Graduation degree	Specializeddegree (Master's, PHD)	Rank	Subject to teach	Signature

Department's approval

faculty's or institute's approval

C : External educational team mobilized for the specialty: (To be provided and approved by the faculty or institute

Noun and pronoun	Affiliation institution Attendance record/Checking attendance	Degree of graduation	Specializeddegree (Master's, PhD)	Rank	Subjects to teach	Signature

Department's approval

faculty's or institute's approval

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

Rank	InternalWorkforce	ExternalWorkforce	Total
Professors			
Lecturer (A)			
Lecturer(B)			
Assistant Professors (A)			
Assistant Professors (B)			
Other (*)			
Total			

(*) Technical and support staff

5 -Means of specific materials for the specialty

A- Pedagogical Laboratories and Equipments: sheet of existing pedagogical equipments for practical work in the intended curriculum (1 sheet per laboratory)

Laboratorytitle:

Studentcapacity:

N°	Equipment Designation	Number	Observations

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

Internship location	Number of students	Internship duration

C- Documentation available at the specific institution for the proposed curriculum (mandatory field)

D- Spaces for personal work and available ICTs at the department and faculty

II – Semestrial organization sheets of the course (curriculum) in the specialty

Semester 1

Teaching unit	subject	Credits	Coefficient	Weekly class hours			Semester Hourly Volume SHV (15 Weeks)	Supplementary Work in consultation (15 weeks)	Evaluation method	
	Title			**Lesson**	**Tutorial (TD)**	**PW(Lab) TP**			**Continuousassessment**	**Exam**
TU Fondamental Code : TUF 1.1 Credits : 18 Coefficients : 9	Mathematics 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physics 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Matter structure	6	3	3h00	1h30		67h30	82h30	40%	60%
TUMethodological Code : TUM 1.1 Credits : 9 Coefficients : 5	PWPhysics 1	2	1			1h30	22h30	27h30	100%	
	PW Chemistry 1	2	1			1h30	22h30	27h30	100%	
	Informatics 1	4	2	1h30		1h30	45h00	55h00	40%	60%
	Writingmethodology	1	1	1h00			15h00	10h00		100%
TU Discovery Code : TUD 1.1 Credits : 1 Coefficients : 1	Jobs in Sciences and Technologies 1	1	1	1h30			22h30	02h30		100%
TU Transversal Code : TUT 1.1 Credits : 2 Coefficients : 2	Ethical and deontological dimension (fondations)	1	1	1h30			22h30	02h30		100%
	Foreign language 1 (French and/or English)	1	1	1h30			22h30	02h30		100 %
		30	**17**	**16h00**	**4h30**	**4h30**	**375h00**	**375h00**		

Total semester 1										

Semester 2

Teaching Unit	Subject	Credits	Coefficient	Weekly class hours			Semester Hourly Volume SHV(15 weeks)	Supplementary Work in consultation (15 weeks)	Evaluation method	
	Title			**Lesson**	**Tutorial (TD)**	**PW(Lab) TP**			**Continuousassessment**	**Exam**
TU Fondamental Code : TUF 1.2 Credits : 18 Coefficients : 9	Mathematics 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physics 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Thermodynamics	6	3	3h00	1h30		67h30	82h30	40%	60%
TEMethodological Code : UEM 1.2 Credits : 9 Coefficients : 5	PW Physics 2	2	1			1h30	22h30	27h30	100%	
	PW Chemistry 2	2	1			1h30	22h30	27h30	100%	
	Informatics 2	4	2	1h30		1h30	45h00	55h00	40%	60%
	Presentationmethodology	1	1	1h00			15h00	10h00		100%
TE Discovery Code : TED 1.2 Credits : 1 Coefficients : 1	Jobs in sciences and technologies 2	1	1	1h30			22h30	02h30		100%
TE Transversal Code : TET 1.2 Credits : 2 Coefficients : 2	Foreign language 2 (French and/orEnglish)	2	2	3h00			45h00	05h00		100 %
Total semester2		**30**	**17**	**16h00**	**4h30**	**4h30**	**375h00**	**375h00**		

Semester3

Teaching Unit	Title	Credits	Coefficient	Weekly class hours			Semester Hourly Volume SHV(15 weeks	Supplementary Work in consultation (15 weeks)	Evaluation method	
				Lesson	**Tutorial (TD)**	**PW(Lab) TP**			**Continuousassessment**	**Exam**
TU Fondamental Code : TUF 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%
TU Fondamental Code : TUF 2.1.2 Credits : 8 Coefficients : 4	Fluidmechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Inorganicchemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
TUMethodological Code : UEM 2.1 Credits : 9 Coefficients : 5	Probabilitiesand statistics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Informatics 3	2	1			1h30	22h30	27h30	100%	
	Technicaldrawing	2	1			1h30	22h30	27h30	100%	
	PWWaves and vibrations	1	1			1h00	15h00	10h00	100%	
TU Discovery Code : TUD 2.1 Credits : 2 Coefficients : 2	HSE industrial installations	1	1	1h30			22h30	02h30		100%
	Regulation and standards	1	1	1h30			22h30	02h30		100%
TU Transversal Code : TUT 2.1 Credits : 1 Coefficients : 1	Technical English	1	1	1h30			22h30	02h30		100%
Total semester 3		**30**	**17**	**13h30**	**7h30**	**4h00**	**375h00**	**375h00**		

Semester 4

Teaching Unit	Subject	Credits	Coefficient	Weekly class hours			Semester Hourly Volume SHV(15 weeks)	Supplementary Work in consultation (15 weeks)	Evaluation method	
	Title			**Lesson**	**Tutorial (TD)**	**PW(Lab) TP**			**Continuousassessment**	**Exam**
TU Fondamental Code : TEF 2.2.1 Credits : 8 Coefficients : 4	Chemistry of solutions	4	2	1h30	1h30		45h00	55h00	40%	60%
	Organicchemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Fondamental Code : TUF 2.2.2 Credits : 8 Coefficients : 4	Chemical thermodynamics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Numericalmethodes	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Fondamental Code : TUF 2.2.3 Credits : 2 Coefficients : 1	Chemical kinetics	2	1	1h30			22h30	27h30		100 %
TUMethodologicalCode : TUM 2.2 Credits : 9 Coefficients : 5	PW Chemistry of solutions	2	1			1h30	22h30	27h30	100%	
	PWOrganicchemistry	1	1			1h00	15h00	10h00	100%	
	PWFluidmechanics	2	1			1h30	22h30	27h30	100%	
	PWNumericalmethods	2	1			1h30	22h30	27h30	100%	
	PWChemical kinetics	2	1			1h30	22h30	27h30	100%	
TU Discovery Code : TUD 2.2 Credits : 2	Introduction to refining and petrochemistry	1	1	1h30			22h30	02h30		100 %

Coefficients : 2	Notions of Transfer phenomena	1	1	1h30			22h30	02h30		100 %
TU Transversal Code : TUT 2.2 Credits : 1 Coefficients : 1	Expression, information and communication techniques	1	1	1h30			22h30	02h30		100 %
Total semester 4		**30**	**17**	**12h00**	**6h00**	**7h00**	**375h00**	**375h00**		

Semester 5

Teaching Unit	Subject	Credits	Coefficient	Weekly class hours			Semester Hourly Volume SHV(15 weeks)	Supplementary Work in consultation (15 weeks)	Evaluation method	
	Title			Lesson	Tutorial (TD)	PW(Lab) TP			Continuous assessment	Exam
TU Fondamental Code : UETUF 3.1.1 Credits : 10 Coefficients : 5	Heat transfert r	4	2	1h30	1h30		45h00	55h00	40%	60%
	Matter transfert	4	2	1h30	1h30		45h00	55h00	40%	60%
	Transfert of momentum	2	1	1h30			22h30	27h30		100%
TU Fondamental Code : UEF 3.1.2 Credits : 8 Coefficients : 4	Electrochemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
	Instrumentation -sensors	2	1	1h30			22h30	27h30		100%
	Chemical kenetics and homogenuous catalysis	2	1	1h30			22h30	27h30		100%
TUMethodological Code : TU 3.1 Credits : 9 Coefficients : 5	Analysis techniques	4	2	1h30		1h30	45h00	55h00	40%	60%
	PWPhysical chemistry 1 and chemical engineering 1	2	1			1h30	22h30	27h30	100%	
	Macroscopic balances	3	2	1h30	1h00		37h30	37h30	40%	60%
TU Discovery Code : TUD 3.1 Credits : 2 Coefficients : 2	Pharmaceutical processses	1	1	1h30			22h30	02h30		100%
	Agri-foodProcessses	1	1	1h30			22h30	02h30		100%
TU Transversal Code : TUT 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**		

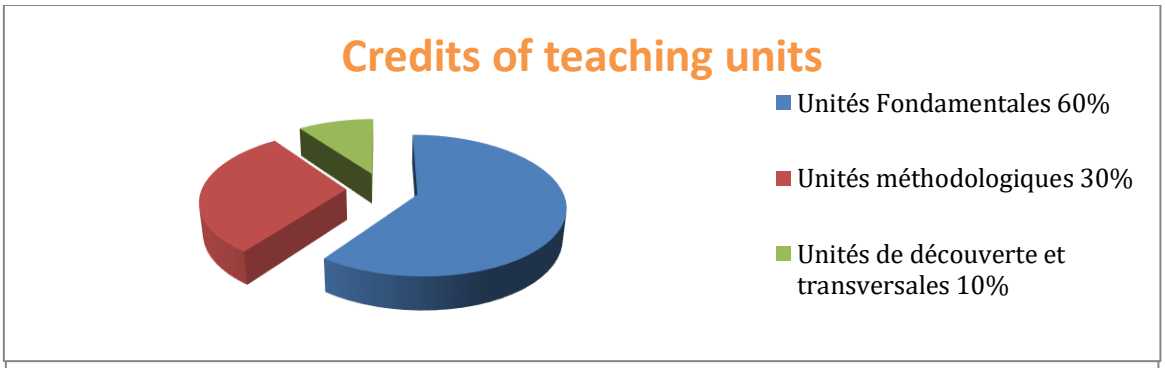
Semester 6

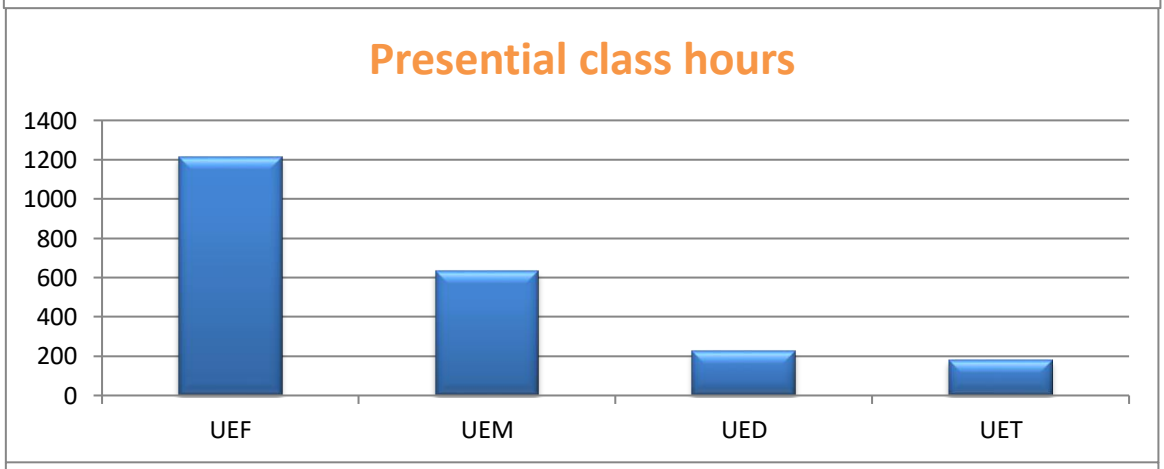
Teaching Unit	Subjecgt	Crédits	Coefficient	Weekly class hourshebdomadaire			Semester Hourly Volume SHV(15 weeks)	Supplementary Work in consultation (15 weeks)	Evaluation method	
	Title			Lesson	Tutorial (TD)	PW(Lab) TP			Continuousassessment	Exam
TU Fondamental Code : TUF 3.2.1 Credits : 10 Coefficients : 5	Unit operations	6	3	3h00	1h30		67h30	82h30	40%	60%
	Thermodynamics of equilibria	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Fondamental Code : TUF 3.2.2 Credits : 8 Coefficients : 4	Homogenuousreactors	4	2	1h30	1h30		45h00	55h00	40%	60%
	Surface phenomena and heterogenous catalysis	4	2	1h30	1h30		45h00	55h00	40%	60%
TU Methodological Code : TUM 3.2 Credits : 9 Coefficients : 5	Final cycle project	4	2			3h00	45h00	55h00	100%	
	Process Simulators	3	2	1h30		1h00	37h30	37h30	40%	60%
	PW Physical chemistry 2 and Chemical engineering 2	2	1			1h30	22h30	27h30	100%	
TU Discovery Code : TUD 3.2 Credits : 2 Coefficients : 2	Cryogenicprocesses	1	1	1h30			22h30	02h30		100%
	Corrosion	1	1	1h30			22h30	02h30		100%
TU Transversal Code : TUT 3.2 Credits : 1 Coefficients : 1	Entrepreneurshipandcompany mangement	1	1	1h30			22h30	02h30		100%
Total semester 6		**30**	**17**	**13h30**	**6h00**	**5h30**	**375h00**	**375h00**		

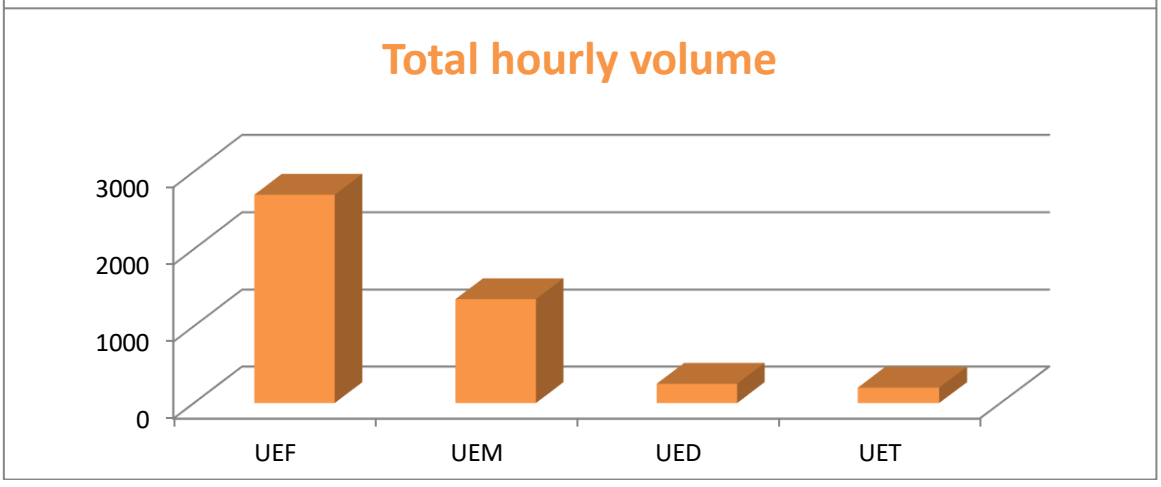
The evaluation methods presented in these tables are given as an indication only, the pedagogical team of the institution may propose other weighting methods

Overall summary of the curriculum:

TU / HV	TUF	TUM	TUD	TUT	Total
Lesson	742h30	165h00	225h00	180h00	1312h30
Tutorial (TD)	472h30	45h00	---	---	517h30
Lab (PW/TP)	---	420h00	---	---	420h00
Personalwork	1485h00	720h00	25h00	20h00	2250h00
Others (specify)	---	---	---	---	---
Total	2700h00	1350h00	250h00	200h00	4500h00
Credits	108	54	10	8	180
% in credits for each TU	60 %	30 %	10 %		100 %







III - Programme détaillé par matière

Semester: 1
Teaching unit: TEF 1.1
Subject 1: Mathematics 1
SHV: 67h30 (Lesson: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives: This first mathematics course is primarily focused on homogenizing the level of students entering the university. The first new elements are taught progressively to lead students towards more advanced mathematics. The topics covered in this course are fundamental and among the most used in the field of Science and Technology.

Recommended Prerequisite Knowledge: Basic knowledge of mathematics from high school (sets, functions, equations, etc.).

Course Content:

Chapter 1. Methods of Mathematical Reasoning (1 week) 1-1 Direct reasoning. 1-2 Reasoning by contraposition. 1-3 Reasoning by contradiction. 1-4 Reasoning by counterexample. 1-5 Reasoning by induction.

Chapter 2. Sets, Relations, and Applications (2 weeks) 2-1 Set theory. 2-2 Order relation, equivalence relations. 2-3 Injective, surjective, and bijective applications: definition of an application, direct image, reciprocal image, characteristic of an application.

Chapter 3. Real Functions of One Real Variable (3 weeks) 3-1 Limit, continuity of a function. 3-2 Derivative and differentiability of a function.

Chapter 4. Application to Elementary Functions (3 weeks) 4-1 Power function. 4-2 Logarithmic function. 4-3 Exponential function. 4-4 Hyperbolic function. 4-5 Trigonometric function. 4-6 Inverse function.

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

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

Assessment:

Continuousas sessment: 40%; Exam: 60%.

Références bibliographiques :

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: TUF 1.1
Subject 2: Physics 1
SHV: 67h30 (lesson: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives: To introduce the student to the basics of Newtonian physics through three main parts: Kinematics, Dynamics, and Work and Energy.

Recommended Prerequisite Knowledge: Mathematics and Physics concepts.

Course Contents:

Mathematical Review (2 weeks) 1- Dimensional equations 2- Vector Calculus: scalar product (norm), vector product, functions of several variables, derivation. Vector analysis: gradient, curl, and divergence operators.

Chapter 1. Kinematics (5 weeks) 1- Position vector in coordinate systems (Cartesian, cylindrical, spherical, curvilinear) - Law of motion - Trajectory. 2- Velocity and acceleration in coordinate systems. 3- Applications: Motion of a point particle in different coordinate systems. 4- Relative motion.

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

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

Assessment Method: Continuous assessment: 40%; Exam: 60%

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:TUF1.1
Subject 3: Matter structure
SHV: 67h30 (Lesson: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Objectives of the course:

This course aims to provide students with a basic understanding of chemistry, specifically in topics related to the atom and chemical bonding, chemical elements, the periodic table, and energy quantification. It aims to make students more capable of solving chemistry problems.

Recommended prerequisites:

Basic knowledge of mathematics and general chemistry.

Course content:

Chapter 1: Fundamental Concepts (2 weeks) States and macroscopic characteristics of matter, changes in states of matter, notions of atom, molecule, mole and Avogadro's number, atomic mass unit, atomic and molecular mass, molar volume, Law of Conservation of Mass (Lavoisier), chemical reaction, qualitative and quantitative aspects of matter.

Chapter 2: Main Components of Matter (3 weeks) Introduction: Faraday's experiment and the relationship between matter and electricity, identification of the constituents of matter and thus of the atom, some physical properties (mass and charge), Rutherford's planetary model, presentation and characteristics of the atom (symbol, atomic number Z, mass number A, number of protons, neutrons, and electrons), isotopy and relative abundance of different isotopes, separation of isotopes, and determination of atomic and average atomic mass: mass spectrometry, nuclear binding and cohesion energy, stability of nuclei.

Chapter 3: Radioactivity - Nuclear Reactions (2 weeks) Natural radioactivity (α, β, and γ radiation), artificial radioactivity and nuclear reactions, kinetics of radioactive decay, applications of radioactivity.

Chapter 4: Electronic Structure of the Atom (2 weeks) Wave-particle duality, interaction between light and matter, Bohr's atomic model: hydrogen atom, hydrogen atom in wave mechanics, poly-electronic atoms in wave mechanics.

Chapter 5: Periodic Classification of Elements (3 weeks) Mendeleev's periodic classification, modern periodic classification, evolution and periodicity of physicochemical properties of elements, calculation of radii (atomic and ionic),

successive ionization energies, electron affinity, and electronegativity (Mulliken scale) using Slater's rules.

Chapter 6: Chemical Bonding (3 weeks) Covalent bonding in Lewis theory, polar covalent bonding, dipole moment and partial ionic character of bonding, molecular geometry: Gillespie or VSEPR theory, chemical bonding in quantum mechanics.

Assessment:

Continuous assessment: 40%; Exam: 60%.

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: TUM 1.1
Matière 1: PW Physics1
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Objectives of the teaching: To reinforce theoretical knowledge learned in class with practical hands-on experience through a number of experiments.

Recommended prior knowledge: Basic understanding of Mathematics and Physics.

Content of the course: At least 5 experiments (3 hours each over 15 days):

- Methodology for presenting laboratory reports and error calculations
- Verification of Newton's second law
- Free fall
- Simple pendulum
- Elastic collisions
- Inelastic collisions
- Moment of inertia
- Centrifugal force

Assessment mode: Continuous assessment: 100%.

Semestre: 1
Teaching Unit:TUM 1.1
Subject 2:PW Chemistry 1
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Objectives of the teaching: To reinforce the theoretical knowledge acquired in the structure of matter course through practical manipulations.

Recommended prerequisites: Basic knowledge of chemistry.

Content of the course:

1. Laboratorysafety
2. Preparation of solutions
3. Concepts of uncertainty calculations applied to chemistry
4. Acid-base titration by colorimetry and pH-metry
5. Acid-base titration by conductometry
6. Redox titration
7. Determination of water hardness
8. Ion titration in water: Chloride ion titration by Mohr's method.

Assessment method: Continuous assessment: 100%

Semester: 1
Teaching Unit: TUM1.1
Subject 3: Informatics 1
SHV: 45h00 (Lesson: 1h30, PW: 1h30)
Credits: 4
Coefficient: 2

Objectives and recommendations: The objective of this subject is to enable students to learn how to program using an advanced language (Fortran, Pascal, or C). The choice of language is left to the discretion of each institution. The notion of algorithm should be implicitly addressed during the language learning process.

Recommended prerequisite knowledge: Basic notions of Web technology.

Subject content: Part 1. Introduction to Computer Science (5 Weeks) 1- Definition of computer science 2- Evolution of computer science and computers 3- Information coding systems 4- Principle of computer operation 5- Computer hardware 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- Representation in flowchart 3- Program structure 4- Approach and analysis of a problem 5- Data structure: Constants and variables, Data types 6- Operators: Assignment operator, Relational operators, Logical operators, Arithmetic operations, Operation priorities 7- Input/output operations 8- Control structures: Conditional control structures, Repetitive control structures

Computer Science TP 1: The practical work aims to illustrate the concepts taught during the course. These should begin with the course according to the following schedule: • Introduction TP and familiarization with the computer from a hardware and operating system perspective (exploration of the different functionalities of OS) • Introduction to the use of a programming environment (Editing, Assembly, Compilation, etc.) • Application TP of the programming techniques seen in class.

Mode of evaluation: Continuous assessment: 40%; Exam: 60%.

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: TUM 1.1
Subject 4: Writing methodology
SHV: 15h00 (Lesdson: 1h00)
Credits: 1
Coefficient: 1

Objectives of the course: To familiarize and train students with the current concepts and methodology of writing in the field of Science and Technology. Among the skills to be acquired: Knowing how to introduce oneself; Knowing how to write a resume and cover letter; Knowing how to express oneself in writing or orally in relation to an opinion or an idea; Mastering syntax and spelling in writing.

Recommended prerequisites: Basic French language skills. Basic principles of document writing.

Course content: Chapter 1. Concepts and generalities on writing techniques (2 weeks)

- Definitions, standards
- Applications: writing a summary, letter, or request

Chapter 2. Information retrieval, synthesis, and exploitation (3 weeks)

- Information retrieval in libraries (paper format: books, journals)
- Information retrieval on the internet (digital format: databases, search engines, etc.)
- Applications

Chapter 3. Techniques and procedures of writing (3 weeks)

- Basic principles of writing - Punctuation, Syntax, Sentences
- Sentence length
- Paragraph division
- Use of a neutral style and writing in the third person
- Readability
- Objectivity
- Intellectualrigor and Plagiarism

Chapter 4. Writing a report (4 weeks) Cover pages, Table of contents, Introduction, Methodology, Results, Discussion, Conclusion, Bibliography, Appendices, Summary, and Keywords

Chapter 5. Applications (3 weeks) Writing a practical work report

Evaluation: Final Exam: 100%.

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: TUD 1.1
Subject 1: Jobs in Sciences and Technologies 1
SHV: 22h30 (Lesson: 1h30)
Credits: 1
Coefficient: 1

Objective of the subject: To introduce students, in a first step, to all the fields covered by the Domain of Science and Technology, and in a second step, to a range of professions that these fields lead to. In the same context, this subject introduces the new challenges of sustainable development as well as the new professions that may arise from them.

Recommended prerequisite knowledge: None.

Subject content:

1. What are engineering sciences? (2 weeks) The engineering profession, its history, and challenges of the 21st century, searching for a job/recruitment announcement by keyword, creating a simple job description (job title, company, main activities, required skills (knowledge, know-how, interpersonal skills).
2. Fields of Electronics, Telecommunications, Biomedical Engineering, Electrotechnics, Electromechanics, Optics & Precision Mechanics: (2 weeks)

- Definitions, fields of application (home automation, embedded applications for automobiles, video surveillance, mobile telephony, fiber optics, advanced scientific instrumentation, medical imaging and instrumentation, giant mirrors, contact lenses, electricity transportation and distribution, power generation plants, energy efficiency, industrial equipment maintenance, elevators, wind turbines, etc.)
- The role of specialists in these fields.

3. Fields of Automation and Industrial Engineering: (1 week)

- Definitions, fields of application (automated industrial chains, computerized numerical control machine tools, robotics, stock management, goods traffic management, quality management, etc.)
- The role of specialists in these fields.

4. Fields of Process Engineering, Hydrocarbons, and Petrochemical Industries: (2 weeks)

- Definitions, pharmaceutical industry, agri-food industry, leather and textiles industry, biotechnologies, chemical and petrochemical industry, plastics industry, energy sector (oil, gas), etc.
- The role of specialists in these fields.

5. Sustainable Development (SD): (4 weeks) Definitions, global issues (climate change, demographic transitions, depletion of resources (oil, gas, coal, etc.), depletion of biodiversity, etc.), Sustainable Development Diagram (Sustainable = Viable + Livable + Equitable), SD stakeholders (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-efficient energy, sustainable/ecological mobility, resource recovery (water, metals, and minerals, etc.), sustainable production), Relevance of Sustainable Engineering in ST fields, Relationship between sustainability and engineering, Engineer's responsibility in achieving sustainable projects, etc.

Student personal work for this subject: The teacher in charge of this subject may inform students that they can always be evaluated by asking them to prepare job description cards. Students can be asked to watch a popular science film related to the chosen profession (after being given either the film on an electronic support or the link to this film) and then submit a written report or give an oral presentation of the summary of this film, etc. The bonus for these activities is left to the discretion of the teacher and the training team, who are the only ones able to define the best way to take these personal works into account in the overall grade of the final exam.

Group work: Creating job description cards for professions in each field from recruitment announcements found on job request sites (e.g. http://www.onisep.fr/Decouvrir-les-metiers, www.indeed.fr, www.pole-emploi.fr) (1 field/group). Depending on the capacities of the institutions, it is recommended to use doctoral students and former graduates of the institution in a mentoring/tutoring scheme where each group can call on its tutor to validate its work.

Assesment method : exam 100%

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 : TUT 3.1
Subjecte : Ethical and Deontological Dimension (Foundations)
SHV : 22h30 (Cours : 1h30)
Credits : 1
Coefficient : 1

Objectives of the course:

The main objective of this course is to facilitate the immersion of an individual into student life and their transition into a responsible adult. It aims to develop students' awareness of ethical principles, introduce them to the rules governing life at the university (their rights and obligations towards the university community) and in the workplace, raise awareness of the respect and valorization of intellectual property, and explain the risks of moral ills such as corruption and how to combat them.

Recommended prerequisites:

None

Course content:

I. Fundamental Notions (2 weeks) Definitions:

1. Morality:
2. Ethics:
3. Deontology "Theory of Duty":
4. Law:
5. Distinction between different notions A. Distinction between ethics and morality B. Distinction between ethics and deontology II. References (2 weeks) Philosophical references Religious reference Evolution of civilizations Institutional reference III. University Franchise (3 weeks) Concept of university franchises Regulatory texts University franchise fees University campus actors IV. University Values (2 weeks) Social values Community values Professional values V. Rights and Duties (2 weeks) Student rights Student duties Teacher rights Professor-researcher obligations Administrative and technical staff obligations VI. University Relationships (2 weeks) Definition of the concept of university relationships Student-teacher relationships Student-student relationships Student-staff relationships Student-association member relationships VII. Practices (2 weeks) Good practices for teachers Good practices for students

References

1. Recueil des cours d'éthique et déontologie des universités algériennes.

2. BARBERI (J.-F.), ‘Morale et droit des sociétés’, *Les Petites Affiches*, n° 68, 7 juin 1995.
3. J. Russ, *La pensée éthique contemporaine*, Paris, puf, *Que sais-je ?,* 1995.
4. LEGAULT, G. A., Professionnalisme et délibération éthique, Québec, Presses de l’Université du Québec, 2003.
5. SIROUX, D., ‘Déontologie’, dans M. Canto-Sperber (dir.), Dictionnaire d’éthique et de philosophie morale, Paris, Quadrige, 2004.
6. Prairat, E. (2009). Les métiers de l’enseignement à l’heure de la déontologie. *Education et Sociétés, 23*.
7. https://elearning.univ-annaba.dz/pluginfile.php/39773/mod_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ontologie.pdf .

Semester: 1
Teaching Unit: TUT 1.1
Subject 1: French1
SHV : 22h30 (Lesson: 1h30)
Credits: 1
Coefficient: 1

The objective of this course is to develop the four following language skills: oral comprehension, written comprehension, oral expression, and written expression through the study of texts.

Recommended prerequisites: Basic French.

Course content: We propose a set of topics that cover fundamental sciences, technology, economics, current events, communication, sports, health, etc. The teacher can choose from this list of texts to develop during the course or is free to approach other topics of their choice. The texts can be taken from various communication sources such as newspapers, sports or entertainment magazines, specialized or popular science journals, books, websites, audio and video recordings, etc.

For each text, the teacher will help students develop their language skills: listening, comprehension, oral and written expression. Additionally, the teacher should use the text to identify grammatical structures to be developed during the same class session. We recall here, by way of illustration, a set of grammatical structures that can be used as examples. Of course, it is not necessary to develop all of them or in the same manner. Some may be recalled, and others may be detailed.

Examples of topics	Grammatical structures
Climate change Pollution Electric cars Robots Artificial intelligence Nobel Prize Olympic games Sports in school The Sahara Currency Assembly line work Ecology Nanotechnologies Fiber optic Engineering profession Power plant Energy efficiency Smart building Wind energy Solar energy	Punctuation, proper nouns, articles. Grammatical functions: Noun, Verb, Pronoun, Adjective, Adverb. Complement pronouns: "le, la, les, lui, leur, y, en, me, te,..." Agreements. Negative sentences: Ne...pas, Ne...pas encore, Ne...plus, Ne...jamais, Ne...point,... Interrogative sentences: Questions with "Qui, Que, Quoi," Questions with "Quand, Où, Combien, Pourquoi, Comment, Quel, Lequel." Exclamatory sentences. Reflexive verbs, impersonal verbs. Tenses of the indicative: Present, Future, Past perfect, Simple past, Imperfect. ...

Evaluation mode: Exam: 100%.

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, HeinleCengage Learning, 2011.
17. J. Dubois et al., Les indispensables – Orthographe, Larousse, 2009.

Semester: 1
Teaching Unit: TUT 1.1
Subject 1: English1
SHV: 22h30 (Cours: 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: TUF 1.2
Subject 1: Maths 2
SHV: 67h30 (Lesson: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching Objectives: Students are gradually led towards understanding the mathematics relevant to their university curriculum. By the end of the course, the student should be able to solve first and second degree differential equations, solve integrals of rational, exponential, trigonometric, and polynomial functions, and solve systems of linear equations using various methods.

Recommended prerequisite knowledge: Basic mathematics concepts (differential equations, integrals, systems of equations, etc.)

Course 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 basis, matrix of passage

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

Chapter 3: Integrals (4 weeks) 3-1 Indefinite integral, properties 3-2 Integration of rational functions 3-3 Integration of exponential and trigonometric functions 3-4 Integral of polynomials 3-5 Definite integration

Chapter 4: Differential equations (4 weeks) 4-1 Ordinary differential equations 4-2 First-order differential equations 4-3 Second-order differential equations 4-4 Ordinary differential equations of second order with constant coefficients

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

Assessment method: Continuous assessment: 40%; Exam: 60%.

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: TUF 1.2
Subject: Physics 2
SHV: 67h30 (Lesson: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

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

Recommended prerequisite knowledge: Mathematics 1, Physics 1.

Course content: Mathematical review: (1 week) 1- Length, surface area, volume elements in Cartesian, cylindrical, and spherical coordinate systems. Solid angle, operators (gradient, curl, Nabla, Laplacian, and divergence). 2- Multiple derivatives and integrals.

Chapter I. Electrostatics: (6 weeks) 1- Charges and electrostatic fields. Electrostatic interaction force-Coulomb's law. 2- Electrostatic potential. 3- Electric dipole. 4- Electric field flux. 5- Gauss's law. 6- Conductors in equilibrium. 7- Electrostatic pressure. 8- Capacitance of a conductor and capacitor.

Chapter II. Electrodynamics: (4 weeks) 1- Electric conductors. 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-Savart law, Ampere's theorem, Calculation of magnetic fields created by permanent currents. 2- Induction phenomena: Induction phenomena (circuit in a varying magnetic field and mobile circuit in a permanent magnetic field), Lorentz force, Laplace force, Faraday's law, Lenz's law, Application to coupled circuits.

Mode of evaluation: Continuous assessment: 40%; Exam: 60%

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: TUF 1.2
Subject 3: Thermodynamics
SHV: 67h30 (Lesson: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives: To provide the necessary foundations of classical thermodynamics for applications in combustion and thermal machines. To homogenize students' knowledge. The skills to be acquired are: acquiring a scientific basis of classical thermodynamics, applying thermodynamics to various systems, and stating, explaining, and understanding the fundamental principles of thermodynamics.

Recommended prerequisite knowledge: Basic mathematics.

Course content: Chapter 1: Generalities 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 a system's state (operation, evolution). 7- Review of the ideal gas laws.

Chapter 2: The first law of thermodynamics: (3 weeks)

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

Chapter 3: Applications of the first law of thermodynamics to thermochemistry (3 weeks) Reaction heats, standard state, standard enthalpy of formation, dissociation enthalpy, enthalpy of physical state change, enthalpy of a chemical reaction, Hess's law, Kirchoff's law.

Chapter 4: The second law of thermodynamics (3 weeks) 1- The second law for a closed system. 2. Statement of the second law: Entropy of an isolated closed system. 3. Calculation of 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 Third Law and absolute entropy (1 week)

Chapter 6: Free energy and enthalpy - Criteria for a system's evolution (2 weeks) 1- Introduction. 2- Free energy and enthalpy. 3- Chemical equilibria.

Assessment method: Continuous assessment: 40%; Exam: 60%

References:

1. C. Coulon, S. LeBoiteux S. et P. Segonds,ThermodynamiquePhysique - 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: TUM 1.2
Subject1: PW Physics 2
SHV: 45h00 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives: To reinforce, through practical work sessions, the theoretical concepts covered in Physics 2.

Recommended prerequisite knowledge: Mathematics 1, Physics 1.

Course content:

Minimum of 5 practical exercises (3 hours each over a period of 15 days):

- Introduction to measurement instruments and tools (voltmeter, ammeter, rheostat, oscilloscopes, generator, etc.).
- Kirchhoff's laws (mesh law, nodal law).
- Thevenin's theorem.
- Inductance and capacitance association and measurement.
- Charging and discharging of a capacitor.
- Oscilloscope experiments.
- Practical work on magnetism.

Assessment: Continuous assessment: 100%

Semester: 2
Teaching Unit:TUM 1.2
Subject 2:PW Chemistry 2
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives: To reinforce the theoretical concepts covered in the Thermodynamics course through Practical Work sessions.

Recommended prerequisite knowledge: Thermodynamics.

Course Content:

1. Ideal Gas Laws.
2. Water equivalent of calorimeter.
3. Specific heat capacity: specific heat capacity of liquids and solids.
4. Latent heat: Latent heat of fusion of ice.
5. Heat of reaction: Determination of the energy released by a chemical reaction (HCl/NaOH).
6. Hess's Law.
7. Vapor pressure of a solution.

Assessment: Continuous assessment: 100%

Semester: 2
Teaching Unit: TUM1.2
Subject3: Informatics 2
SHV: 45h00 (Cours: 1h30, TP: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives To master basic programming and algorithmic techniques. To acquire fundamental concepts in computer science. The skills to be acquired are: programming with a certain degree of autonomy; designing algorithms from simple to relatively complex.

Recommended prerequisites Knowing how to use the university website, file systems, Windows user interface, and programming environment.

Course content:

Chapter 1: Indexed Variables (4 Weeks) 1- One-dimensional arrays: representation in memory, operations on arrays 2- Two-dimensional arrays: representation in memory, operations on two-dimensional arrays

Chapter 2: Functions and Procedures (6 Weeks) 1- Functions: types of functions, function declaration, function calling 2- Procedures: concepts of global and local variables, simple procedures, procedures with arguments

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

Computer Science Practical 2: A certain number of practical works should be planned to materialize the programming techniques seen during the course.

- Practical works on the application of programming techniques seen in the course.

Evaluation mode: Continuous assessment: 40%; Exam: 60%

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: TUM 1.2
Subject 4: presentation methodology
SHV: 15h00 (Lesson: 1h00)
Credits: 1
Coefficient: 1

Objectives of the course: To provide the main foundations for successfully delivering an oral presentation. The skills to be acquired include: Knowing how to prepare a presentation; Knowing how to deliver a presentation; Knowing how to capture the audience's attention; Becoming aware of the pitfalls of plagiarism and knowing the regulations of intellectual property.

Recommended prerequisites: Techniques of expression and communication and Methodology of writing.

Course content:

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

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

Chapter 3: Plagiarism and Intellectual Property (3 weeks) 1- Plagiarism: Definitions of plagiarism, consequences of plagiarism, how to borrow from other authors' work, quotations, illustrations, how to avoid plagiarism? 2- Writing a bibliography: Definition, objectives, how to present a bibliography, writing the bibliography.

Chapter 4: Presenting a Written Work (6 weeks) Presenting a written work.
Applications: delivering an oral presentation.

Assessment method: Exam: 100%.

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 une soutenance, 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 en public. 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 How to Improve Technical Presentations, Imperial College Press, 2000.

10. M. Markel, Technical communication, eleventh edition, Bedford/St Martin's, 2015.

Semestre: 2
Teaching Unit: TUD 1.2
Subject1: Jobs in Sciences and Technology 2
SHV: 22h30 (Lesson: 1h30)
Credits: 1
Coefficient: 1

Aim of the subject: To introduce the student, in a first step, to all the fields covered by the domain of Science and Technology and, in a second step, to a range of professions resulting from these fields. In the same context, this subject introduces the student to the new challenges of sustainable development as well as the new professions that may arise from it.

Recommended prior knowledge: None.

Content of the subject:

1. Industrial Hygiene and Safety (HSI) and Mining Engineering fields: (2 weeks)
- Definitions and areas of application (Safety of property and people, Environmental issues, Exploration and Exploitation of mineral resources, etc.)
- The role of the specialist in these fields.
2. HVAC and Transportation Engineering fields: (2 weeks)
- Definitions, areas of application (Air conditioning, Intelligent buildings, Transport safety, Traffic management and road, air, and naval transport, etc.)
- The role of the specialist in these fields.
3. Civil Engineering, Hydraulics, and Public Works fields: (2 weeks)
- Definitions and areas of application (Construction materials, Major road and rail infrastructures, Bridges, Airports, Dams, Drinking water supply and Sanitation, Hydraulic flows, Water resource management, Public Works and Territorial Planning, Smart cities, etc.)
- The role of the specialist in these fields.
4. Aeronautics, Mechanical Engineering, Maritime Engineering, and Metallurgy fields: (2 weeks)
- Definitions and areas of application (Aeronautics, Avionics, Automotive industry, Ports, Dikes, Production of industrial equipment, Steelmaking, Metal transformation, etc.)
- The role of the specialist in these fields.
5. Approaches to sustainable production: (2 weeks) Industrial ecology, Remanufacturing, Eco-design.
6. Measuring the sustainability of a process/product/service: (2 weeks) Environmental analysis, Life Cycle Assessment (LCA), Carbon footprint, case studies/applications.
7. Sustainable development and Enterprise: (3 weeks) Definition of the enterprise as an economic entity (notions of profit, costs, performance) and social entity (notion of corporate social/societal responsibility), Impact of economic activities on the environment (examples), Challenges/Benefits of SD for the enterprise, Means of engagement in an SD approach (e.g. ISO 14001 certification, labeling (e.g. Energy labeling, Ecolabel, Bio/AB Label, FSC Label, etc.), SD strategic plan, Global Reporting Initiative (GRI), Worldwide rankings of the most sustainable companies (Dow Jones Sustainable Index, Global 100, etc.), Case studies of successful/eco-responsible companies in the ST sectors (e.g. SIEMENS, Cisco, Henkel AG& Co, TOTAL, Peugeot, Eni SPA ...).

Student's personal work for this subject:

- Group work/pair work: Reading articles on sustainable development and/or reports on sustainable and successful companies and summarizing the main actions taken in the field of SD. Examples of documents for reading and summarizing:
- ONA and ENIEM Case: Kadri, Mouloud, 2009, Sustainable Development, Enterprise and ISO 14001 Certification, Market and Organizations vol. 1 (N° 8), p. 201- 215 (freely available online: http://www.cairn.info/revue-marche-et-organisations-2009-1-page-201.htm)
- Mireille Chiroleu-Assouline. The sustainable development strategies of companies. Ideas, La revue des sciences économiques et sociales, CNDP, 2006, p 32-39 (freelyavailable online: http://halshs.archives-ouvertes

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: TUT 1.2
Subject1: french 2
SHV: 22h30 (Lesson: 1h30)
Credits: 1
Coefficient: 1

Objectives of the course: The aim of this subject is to develop the following four skills: Oral comprehension, written comprehension, oral expression, and written expression through reading and studying texts.

Recommended prior knowledge: Basic French.

Content of the course: Below we propose a set of thematic areas that cover fundamental sciences, technology, economics, societal facts, communication, sports, health, etc. The teacher can choose from this list of texts to develop during the course. Otherwise, they are free to address other topics of their choice. The texts can be borrowed from various communication media: daily newspapers, sports or entertainment magazines, specialized or popular science journals, books, websites, audio and video recordings, etc.

For each text, the teacher helps the student to develop their language skills: listening, comprehension, oral and written expression. In addition, they must use the text to identify the grammatical structures that they will develop during the same class session. Here, as an illustration, we remind you of a set of grammatical structures that can be developed as examples. Of course, it is not necessary to develop all of them or in the same way. Some may be briefly mentioned, while others may be detailed.

Examples of themes/topics	**Gramaticalstrucures**
The pharmaceutical industry The agri-food industry The National Employment Agency ANEM Sustainable development Renewable energy Biotechnology Stem cells Road safety Dams Water - Water resources Avionics Automotive electronics Electronic newspapers Carbon dating Violence in stadiums Drug addiction: a social scourge Smoking School failure The Algerian War Social networks China, an economic power Superconductivity Cryptocurrency AdvertisingL'autisme	The subjunctive. The conditional. The imperative. The past participle. The passive form. Possessive adjectives, Possessive pronouns. Demonstratives, Demonstrative pronouns. Expressions of quantity (several, some, enough, a lot, more, less, as much, ...). Numbers and measurements. Pronouns "qui, que, où, dont". Subordinate time preposition. Cause, Consequence. Purpose, Opposition, Condition. Comparatives, Superlatives.. ...

Evaluation mode : exam 100%.

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, HeinleCengage Learning, 2011.
17. J. Dubois et al., Les indispensables – Orthographe, Larousse, 2009.

Semester: 2
Teaching Unit: TUT 1.2
Subject: English 2
SHV: 22h30 (Cours: 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.

Semester: 3
Teaching Unit: TUF 2.1.1
Subject 1: Mathematics 3
SHV: 67h30 (Lesson: 3h00, TD: 1h30)
Credits: 6
Coefficient: 3

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

Recommended prerequisites: Mathematics 1 and Mathematics 2.
Content of the course: Chapter 1: Simple and Multiple Integrals 3 weeks 1.1 Review of Riemann integral and 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 end.

Chapter 3: Differential Equations 2 weeks 3.1 Review of ordinary differential equations. 3.2 Partial differential equations. 3.3 Special functions.

Chapter 4: Series 3 weeks 4.1 Numerical series. 4.2 Sequences and series of functions. 4.3 Power series, Fourier series.

Chapter 5: Fourier Transform 3 weeks 5.1 Definition and properties. 5.2 Application to the solution of differential equations.

Chapter 6: Laplace Transform 2 weeks 6.1 Definition and properties. 6.2 Application to the solution of differential equations

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

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: TUF 2.1.1
Subject 2:Waves and Vibrations
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives: To introduce students to mechanical vibration phenomena limited to low-amplitude oscillations for 1 or 2 degrees of freedom, as well as to the study of mechanical wave propagation.

Recommended prerequisites: Mathematics 2, Physics 1, and Physics 2.

Course content: Introduction: This course is divided into two parts, Waves and Vibrations, which can be approached independently of each other. It is advisable to cover Waves first, followed by Vibrations for students in Electrical Engineering (Group A). For students in Groups B and C (Civil Engineering, Mechanical Engineering, and Process Engineering), it is best to begin with Vibrations. In any case, the instructor is expected to cover both parts. We remind you that this course is intended for engineering professions in the Science and Technology field. Therefore, the instructor is requested to skim over all parts of the course that require demonstrations or theoretical developments and to focus solely on the practical aspects. Demonstrations can be assigned to students as auxiliary activities as part of their personal work. Please refer to the paragraph "G-Student Evaluation through Continuous Assessment and Personal Work" in this course description.

Part A: Vibrations 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 friction forces dependent on velocity 1.1.4 Case of an external force dependent on time 1.2 System with several degrees of freedom.

Chapter 2: Free oscillations of single-degree-of-freedom systems 2 weeks 2.1 Non-damped oscillations 2.2 Free oscillations of damped systems

Chapter 3: Forced oscillations of single-degree-of-freedom systems 1 week 3.1 Differential equation 3.2 Mass-spring-damper system 3.3 Solution to the differential equation 3.3.1 Harmonic excitation 3.3.2 Periodic excitation 3.4 Mechanical impedance

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

Chapter 5: Forced oscillations of two-degree-of-freedom systems 2 weeks 5.1 Lagrange equations 5.2 Mass-spring-damper systems 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 Generalities and basic definitions 1.2 Propagation equation 1.3 Solution to the propagation equation 1.4 Sinusoidal progressive wave 1.5 Superposition of two sinusoidal progressive waves

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

Chapter 3: Acoustic waves in fluids 1 week 3.1 Wave equation 3.2 Speed of sound 3.3 Sinusoidal progressive 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

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

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 : TUF 2.1.2
Subject1: Mechanics of fluids
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient: 2

Chapter 1: Generalities on Fluid Mechanics. (2 weeks)

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

Chapter 2: Physical Properties of Fluids. (2 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, dimension equations, and units.

Chapter 3: Hydrostatics. (3 weeks)

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

Chapter 4: Conservation of Mass. (2 weeks)

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

Chapter 5: Perfect Fluid. (5 weeks)

V.1 Mechanics review; V.2 Conservation of momentum theorem.; V.3 Euler equations.; V.4 Bernoulli's theorem.; V.5 Examples of Bernoulli's theorem applications: Pitot tube; Venturi nozzle; Unsteady tank draining; V.6 Air exhaust from a pressurized tank: compressibility limit.

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

References:

R.Comolet,'Mécaniquedesfluidesexpérimentale',Tome1,2et3,Ed.MassonetCie.R.Ouzia ux,'Mécaniquedesfluidesappliquée',Ed.Dunod,1978
B.R.Munson,D.F.Young,T.H.Okiishi,'Fundamentalsoffluidmechanics',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 : TUF 2.1.2
Subject 1: Inorganic chemistry
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient: 2

Objectives of the course:

To provide basic knowledge of mineral chemistry To learn some methods such as crystallography and synthesis.

Recommended prerequisite knowledge:

Basic knowledge of general chemistry

Course content:

Chapter 1: Review of some important definitions: 1 week

Mole, molar mass, molar volume, mole fraction, mass fraction, volume fraction; Density, mass density; Relation between mass fraction and mole fraction; Material balance: Concept of reactant and excess reactant, Concept of excess percentage, Concept of conversion percentage.

Chapter 2: Crystallography 3 weeks

Polyhedral description of structures, connectivity.

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

Halogens, chalcogens, nitrogen and phosphorus, boron.

Chapter 4: Major metallurgies 4 weeks

(Fe, Ti, Cu, Mg)

Chapter 5: Major mineral syntheses 4 weeks

(H_2SO_4, H_3PO_4, NH_3, HNO_3)

Assessment mode:

Continuous assessment: 40%; Final exam: 60%

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: TUM2.1
Subject 1:Probabilities and Statistics
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits: 4
Coefficient: 2

Aims of the subject: This matter enables students to learn the essential concepts of probability and statistics, including: statistical series with one and two variables, probability on a finite universe, and random variables.

Recommended prerequisite knowledge: Mathematics 1 and Mathematics 2

Subject content: Part A: Statistics Chapter 1: Basic Definitions (1 week) A.1.1 Concepts of population, sample, variables, modalities A.1.2 Different types of statistical variables: qualitative, quantitative, discrete, continuous.

Chapter 2: Statistical Series with One Variable (3 weeks) A.2.1 Frequency, percentage A.2.2 Cumulative frequency A.2.3 Graphical representations: bar chart, pie chart, stem and leaf plot, polygon, histogram, cumulative curves A.2.4 Measures of central tendency A.2.5 Measures of dispersion: range, variance, standard deviation, coefficient of variation A.2.6 Measures of shape.

Chapter 3: Statistical Series with Two Variables (3 weeks) A.3.1 Data tables (contingency tables), scatter plot A.3.2 Marginal and conditional distributions, covariance A.3.3 Linear correlation coefficient, regression line and Mayer line A.3.4 Regression curves, regression band, correlation ratio A.3.5 Functional adjustment.

Part B: Probability Chapter 1: Combinatorics (1 week) B.1.1 Arrangements B.1.2 Combinations B.1.3 Permutations.

Chapter 2: Introduction to Probability (2 weeks) B.2.1 Algebra of events B.2.2 Definitions B.2.3 Probabilistic spaces B.2.4 General theorems of probability.

Chapter 3: Conditioning and Independence (1 week) B.3.1 Conditioning B.3.2 Independence B.3.3 Bayes' formula.

Chapter 4: Random Variables (1 week) B.4.1 Definitions and properties B.4.2 Distribution function B.4.3 Mathematical expectation B.4.4 Covariance and moments.

Chapter 5: Usual Discrete and Continuous Probability Distributions (3 weeks) Bernoulli, binomial, Poisson, uniform, normal, exponential, etc.

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

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: TUM2.1
Subject 2:Informatics 3
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

The objectives of the course: To teach students programming using easily accessible software (primarily: Matlab, Scilab, Mapple, etc.). This course will be a tool for the implementation of numerical methods labs in S4.

Recommended prerequisites: Basic programming knowledge acquired in Computer Science 1 and 2.

Course content: Lab 1: Introduction to a scientific programming environment (1 week) (Matlab, Scilab, etc.) Lab 2: Script files and data types and variables (2 weeks) Lab 3: Reading, displaying and saving data (2 weeks) Lab 4: Vectors and matrices (2 weeks) Lab 5: Control statements (for and while loops, if and switch statements)(2 weeks) Lab 6: Function files (2 weeks) Lab 7: Graphics (handling graphic windows, plot) (2 weeks) Lab 8: Toolbox utilization (2 weeks)

Assessment method: Continuous assessment: 100%

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 scientifique en Python et Scilab classes préparatoires scientifiques 1er et 2e années, Ellipses, 2010.

Semester: 3
Teaching Unit: TUM2.1
Subject 3 : Technical drawing
VHS: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Objectives of the course: This course will enable students to acquire the principles of representing industrial parts in technical drawing. Furthermore, this subject will allow the student to create and read plans.

Recommended prior knowledge (succinct description of the knowledge required to follow this course - Maximum 2 lines). To be able to follow this course, basic knowledge of general principles of drawing is required.

Content of the course:

Chapter 1: Generalities. 2 Weeks 1.1 Usefulness of technical drawings and different types of drawings. 1.2 Drawing materials. 1.3 Standardization (Types of lines, Writing, Scale, Drawing format and folding, Title block, etc.).

Chapter 2: Elements of descriptive geometry 6 Weeks 2.1 Notions of descriptive geometry. 2.2 Orthogonal projections of a point - Point sketch - Orthogonal projections of a line (any and particular) - Line sketch - Traces of a line - Projections of a plane (any and particular positions) - Traces of a plane. 2.3 Views: Choice and arrangement of views - Dimensioning - Slope and conicity - Determination of the 3rd view from two given views. 2.4 Method of drawing execution (layout, 45° 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: Sections 2 Weeks 4.1 Sections, standardized representation rules (hatching). 4.2 Projections and sectioning of simple solids (Projections and sections of a cylinder, a prism, a pyramid, a cone, a sphere, etc.). 4.3 Half-section, partial sections, broken sections, sections, etc. 4.4 Technical vocabulary (terminology of machined shapes, profiles, piping, etc.). Application exercises and evaluation (PW).

Chapter 5: Dimensioning 2 Weeks 5.1 General principles. 5.2 Dimensioning, tolerance, and fit. Application exercises and evaluation (PW).

Chapter 6: Notions on definition and assembly drawings and nomenclatures. 1 Week Application exercises and evaluation (PW).

Evaluation method: Continuous assessment: 100%

References:

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 AndreCasteilla;
5. **المدخل إلى الرسم الصناعي** ماجد عبد الحميد ديوان المطبوعات الجامعية الجزائر
6. **مبادئ أساسية في الرسم الصناعي** عمر أبو حنيك المعهد الجزائري للتقييس والملكية الصناعية طبع الحميد ديوان المطبوعات الجامعية الجزائر

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

Semester: 3
Teaching Unit: TUM 2.1
Subject 4:PWWaves and vibrations
SHV: 15h00 (PW: 1h00)
Credits: 1
Coefficient: 1

Objectives of the course: The objectives of this program are to introduce students to the practical application of their knowledge 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.

Course content: PW1: Mass-spring system

PW2: Simple pendulum

PW3: Torsion pendulum

PW4: Oscillating electrical circuit in free and forced regimes

PW5: Coupled pendulums TP6: Transverse oscillations in vibrating strings

PW7: Hoffmann's pulley-groove system

PW8: Electromechanical systems (the electrodynamic loudspeaker)

PW9: Pohl's pendulum

TPW10: Longitudinal wave propagation in a fluid.

Note: It is recommended to choose at least 5 TP out of the 10 proposed.

Mode of evaluation: Continuous assessment: 100%.

Bibliographic references

Semester: 3
Teaching Unit: UED2.1
Subject 1: HSE Industrial Installations
SHV: 22h30 (Lesson: 1h30)
Credits: 1
Coefficient: 1

Learning Objectives: • Identify and evaluate risks; • Implement appropriate prevention methods; • Control the reality and effectiveness of implemented devices.

Recommended Prior Knowledge:

Course Contents:

Chapter 1: Introduction to risk assessment and management, accident analysis 7 weeks 1.1 Understand basic concepts (hazard, risk) and identify prevention actors; 1.2 Master the indicators related to occupational accidents (frequency rate, severity rate, etc.) and occupational diseases; 1.3 Observe and analyze risks related to a work situation; 1.4 Develop a root cause analysis.

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 habitat 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 different organizations in occupational health and safety and public health.

Assessment Method: Final exam: 100%.

Bibliographical References: (According to the availability of documentation at the institution, websites, etc.

Semester: 3
Teaching Unit: TUD2.1
Subject 2: Regulation and standards
SHV: 22h30 (Lesson: 1h30)
Credits: 1
Coefficient : 1

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

Recommended prerequisites:

Course content:

Chapter 1: Introduction 3 weeks 1.1 Regulation and regulatory texts. 1.2 Economic development and standardization.

Chapter 2: Standardization 4 weeks 2.1 Object and development. Standardization associations and organizations. 2.2 International standardization. Standardization in Algeria: INAPI.

Chapter 3: Production standardization 4 weeks 3.1 Normative parameters. Product interchangeability. Tolerances and adjustments. 3.2 Methods of conformity control and certification.

Chapter 4: Classification 4 weeks Classification of products. Classification of standards and their codification.

Mode of evaluation: Final exam: 100%.

Bibliographic references: (According to the availability of documentation at the institution, websites, etc.)

Semester: 3
Teaching Unit: TUT 2.1
Subject1: Technical English
SHV: 22h30 (Lesson: 1h30)
Credits: 1
Coefficient: 1

The teaching objectives of this course are to enable the student to acquire a significant level of language proficiency, which would allow them to use scientific documents and speak about their specialty and field of study in English with ease and clarity.

Recommended prerequisites: English 1 and English 2

Course content:

- Oral comprehension and expression, vocabulary acquisition, grammar, etc.
- Nouns and adjectives, comparatives, following and giving instructions, identifying things.
- Use of numbers, symbols, equations.
- Measurements: length, area, volume, power, etc.
- Describing scientific experiments.
- Characteristics of scientifictexts.

Assessment method: Final 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. 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 : TUF 2.2.1
Subject 1: Chemistry of solutions
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient : 2

Objective of teaching: The objective is to provide the student with the basic concepts related to the chemistry of solutions. The course aims to familiarize the student with the reasoning of solution chemistry in order to predict chemical reactions for analytical purposes.
The main objectives are:

- 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 reductant and predict redox reactions.

Recommended prerequisites: Basic knowledge of general chemistry.

Content of the course: Chapter 1: Solutions 3 weeks Definitions: Concentrations: molarity, normality, molality, titration, mole and mass fraction, activity, etc. Conductometry: ion mobility, electrolytes (strong, weak), conductivity (specific and molar), conductimetric cell, Kohlrausch's law, conductometric titration.

Chapter 2: Acids and Bases 3 weeks Acid-base equilibria in aqueous solutions: acidity scale, acid constant (Ka, pKa), dilution law (Oswald), pH calculation (simple solutions, mixtures, saline solutions, buffer solutions, ampholytic solutions), prediction of reactions, acid-base titration (polyacids and polybases). Colored indicators.

Chapter 3: Redox reactions 3 weeks Definition, oxidant, reductant, redox reactions, oxidation state, balancing redox reactions, electrochemical cells, thermodynamic aspects, electrodes.

Chapter 4: Solubility 3 weeks Definition, graphical representation, common ion effect, pH influence on solubility (hydroxides case), potential influence on solubility, complexation influence on solubility.

Chapter 5: Complexes 3 weeks Definition, nomenclature of complexes, complex formation, stability of complexes, pH effect on complexes, potential effect on complexes, some applications of complexes.

Evaluation: Continuous assessment: 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 : UEF 2.2.1
Subject 1: Organic Chemistry
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient: 2

Objectives of teaching:

- Introduce basic concepts of organic chemistry and present the main functional derivatives in order to understand industrial chemistry processes.
- Description of mechanisms for obtaining different functions and the main reactions encountered in organic chemistry.

Recommended prerequisites: Basic knowledge of carbon and concepts of chemical bonding.

Course content:

Chapter 1: Generalities 3 weeks Study of the carbon atom and its bonds Functions and nomenclature of organic compounds: Ordinary, trivial, common, and systematic nomenclature by IUPAC.

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 Stereoisomerism 4 weeks Definition, plane isomerism (definition), functional isomerism, positional isomerism, tautomerism, geometric isomerism, stereochemistry: definition, representation of molecules in space, configuration isomerism.

Chapter 4: Electronic Effects 3 weeks

- Definition, Chemical bonds: pure covalent, polar covalent, and ionic bonds. Inductive effect: definition, classification of inductive effects, influence of inductive effects on the acidity of a chemical compound, influence of inductive effects on the basicity of an organic compound. Mesomeric effect: definition, conjugated systems, and electron delocalization. Classification of mesomeric effects, influence of mesomeric effects on the acidity of a chemical compound, influence of mesomeric effects on the basicity of an organic compound.

Chapter 5: Major Reactions in Organic Chemistry 3 weeks Reagents and reaction intermediates; Classification of reactions: Addition, Substitution, Elimination, Rearrangement; Basic rules: Markovnikov, Zeitsev.

Evaluation mode: Continuous assessment: 40%; Final exam: 60%

References:

1-PaulArnaud, Chimieorganique,DUNOD;2004.
2-JeanpierreMercier,Pierre Gaudard Chimie organique: une initiation; Presses polytechniques Romandes 2001.
3-MelaniaKiel Chimie organique cours et exercices corrigés;;estem;2004.
4-JonathanClayden,NickGreeves,Stuart Warren,André Pousse,Chimie organique; De Boeck2^{e}édition;2013.
5-JohnMcMurry,EricSimanek, Chimie organique les grands principes;DUNOD2^{e}édition; 2007.

Semester :4
Teaching Unit : TUF 2.2.2
Subject 1: ChemicalThermodynamics
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient: 2

Teaching Objectives: -Mastering the 1st, 2nd, and 3rd principles of thermodynamics. -Application of thermodynamic principles. -Study of chemical equilibria, chemical potential, and real gases.

Recommended Prerequisite Knowledge: Differential equations, basic chemical thermodynamics (S2 of the common core of ST).

Course Content:

Chapter I: Thermodynamics Review (2 weeks) I.1 Mathematical review on partial derivatives I.2 Variables and state functions I.3 Thermodynamic systems and properties I.4 The different principles of thermodynamics I.5 Criterion for system evolution 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 deviations, and fugacity II.5 Thermodynamic properties of condensed states

Chapter III: Phase Equilibria of Pure Substances (4 weeks) III.1 General equilibrium relations (Clapeyron and Clapeyron-Clausius) III.2 Liquid-vapor, liquid-solid, and solid-vapor equilibria III.3 Stable and unstable equilibria and phase transitions III.4 Generalized diagrams

Chapter IV: Chemical Equilibria (5 weeks) IV.1 The affinity of a chemical reaction IV.2 Monothermic-monobaric and monochoric systems IV.3 Heat of a chemical reaction and Hess's and Kirchoff's laws IV.4 Law of mass action and chemical equilibrium displacement

Evaluation mode: Continuous assessment: 40%; Final exam: 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 : TUF 2.2.2
Subject 2: Numerical Methods
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient: 2

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

Recommended prerequisite knowledge: Mathematics 1, Mathematics 2, Computer Science 1, and Computer Science 2.

Course Content:

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. Successive approximation method (fixed point)
5. Newton-Raphson method

Chapter 2: Polynomial Interpolation (2 weeks)

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

Chapter 3: Function Approximation (2 weeks)

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

Chapter 4: NumericalIntegration (2 weeks)

1. General introduction
2. Trapezoidalrule
3. Simpson'srule
4. Quadrature formulas

Chapter 5: Solving Ordinary Differential Equations (Initial Value Problem or Cauchy Problem) (2 weeks)

1. General introduction
2. Euler'smethod
3. Improved Euler method
4. Runge-Kuttamethod

Chapter 6: Direct Method for Solving Linear Equation Systems (2 weeks)

1. Introduction and definitions
2. Gaussian elimination and pivoting
3. LU factorization method
4. Cholesky factorization method
5. Thomas algorithm (TDMA) for tridiagonal systems

Chapter 7: Approximate Method for Solving Linear Equation Systems (2 weeks)

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

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

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 : TUF 2.2.3
Subject: Chemical Kinetics
SHV: 22h30 (Cours: 1h30)
Credits : 2
Coefficient: 1

Objectives of the subject: To provide the student with the essential foundations for any kinetic study of a chemical process, covering both the basic concepts of formal kinetics and the mathematical basis concerning the notion of the rate of a chemical reaction and its evolution over time, the parameters influencing the rate of a reaction, the determination of the order of a reaction by physicochemical methods, the rate constant, and the activation energy.

Recommended prerequisite knowledge: Mathematics (differentiation, integration), ability to express the concentration of a solution, mastery of unit systems, ability to plot and exploit graphs.

Course contents: Chapter I. Homogeneous chemical reactions (1 week) I. Reaction rate (Absolute rate, specific rate) II. Experimental kinetic study of a reaction (Chemical and physical methods) III. Experimental factors influencing the rate

Chapter II. Influence of concentrations and temperature on the rate (2 weeks) I. Influence of concentration (Order of a reaction, Molecularity and Stoichiometry of a reaction, VANT'Hoff's rule) II. Influence of temperature

Chapter III. Formal kinetics, simple reaction (6 weeks) I. Determination of the rate constant of a reaction of a given order (Zero order, first order, second order, third order, and n order) II. Determination of reactionorders

- Methods for determining the order by integration (variation of concentrations as a function of time, methods of partial reaction times), calculation examples
- Differentialmethod, calculationexample
- Methods based on order degeneracy, calculation example
- Method using dimensionless parameters, calculation example

Chapter IV. Composite reactions (6 weeks)

1. Opposing or equilibriumreactions
- Generalities
- Examples of opposing reactions (both opposing reactions are first order, second order, second order opposing first order, first order opposing second order)
- Equilibrium and reaction rate

- Principle of microreversibility

2. Parallel reactions: generalities, twin reactions, competing reactions, example
3. Successive reactions: determination of rate constants, radioactive equilibrium, calculation example.

Assessment method: Final exam: 100%

References:

1-ClaudeMoreau,Jean-PaulPayen ,Cinétique chimique, EditionBelin1999

2-MichelDestriau,GérardDorthe,RogerBen-Aïm, Cinétique et dynamique chimique EditionTechnip1981.

3-P.Morlaes,Cinétique chimique: Structure de la matière1978

4-B.Frémaux, Eléments de cinétique et de catalyse, 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 : TUM 2.2
Subject 1: PWChemistry of solutions
SHV: 22h30 (PW: 1h30)
Credits : 2
Coefficient : 1

Teaching Objectives: To understand and assimilate the knowledge well.

Recommended prerequisite knowledge: General chemistry and thermodynamics concepts. The student should already be familiar with laboratory equipment and glassware.

Course content: Lab #1. Determination of water hardness by complexometry.

Lab #2. Experimental verification of Nernst's law.

Lab #3. Conductometric titration of vinegar.

Lab #4. Titration, pH monitoring, and Gran's method for determining the alkalinity of an aqueous solution using hydrochloric acid.

Lab #5. Titration, pH monitoring, and conductimetry of a solution of sodium hydroxide.

Lab #6. Identification of cations in the first group.

Lab #7. Determination of the solubility product of a slightly soluble salt.

Lab #8. Measurement of the formation constant of a complex.

Lab #9. Potential-pH diagram of iron.

Evaluation method: Continuous assessment: 100%

References:

1- G. Milazo. Electrochimie. Dunod 1969
2- Brenet. Introduction à l'électrochimie de l'équilibre et du non équilibre. Masson 1980

Semester : 4
Teaching unit : TUM 2.2
Subject 2: PWOrganic chemistry
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 Prerequisite Knowledge: Organic Chemistry

Course Content: Lab #1. Esterification (Synthesis of Aspirin). **Lab #2.** Purification by recrystallization of Benzoic Acid. **Lab #3.** Extraction of an organic product. **Lab #4.** Determination of the composition of a mixture by refractometry. Lab #5. Sublimation of Naphthalene. **Lab #6.** Study of the properties of Phenol or an organic substance. **Lab #7.** Preparation of soap. **Lab #8.** Transformation of an alcohol into a halogenated derivative (Synthesis of 2-chloro-2-methylpropane from 2-methylpropan-2-ol). **Lab #9:** Purification by atmospheric pressure distillation and steam distillation. **Lab #10:** Purification by fractional distillation on column.

Assessment Method: Continuous assessment: 100%.

Semester : 4
Teaching Unit : TUM 2.2
Subject 3: PWFluid mechanics
SHV: 22h30 (PW: 1h30)
Credits : 2
Coefficient : 1

Teaching Objectives: The student will apply the knowledge learned in fluid mechanics in S3.

Recommended prerequisites: Subjects: fluid mechanics and physics 1. Course content:

- Lab #1: Viscosimeter
- Lab #2: Determination of linear and singular pressure losses
- Lab #3: Measurement of flow rates
- Lab #4: Water hammer and mass oscillations
- Lab #5: Verification of Bernoulli'stheorem
- Lab #6: Jet impact
- Lab #7: Flow through an orifice
- Lab #8: Visualization of flows around an obstacle
- Lab #9: Determination of the Reynolds number: laminar and turbulent flow

Evaluation method: Continuous assessment: 100%.

Semester: 4
Teaching Unit: TUM 2.2
Subject 4:TP Numerical methods
SHV: 22h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Teaching Objectives: Programming various numerical methods for their applications in mathematical calculations using a scientific programming language (Matlab, Scilab, etc.).

Recommended prerequisites: Numerical methods, Computer Science 2 and Computer Science 3.

Course content: Chapter 1: Nonlinear Equations Solving 3 weeks

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

Chapter 2: Interpolation and Approximation 3 weeks

1. Newton's interpolation, 2. Tchebychev approximation

Chapter 3: NumericalIntegration 3 weeks

1. Rectangle method, 2. Trapezoidal method, 3. Simpson's method

Chapter 4: Differential Equations 2 weeks

1. Euler'smethod, 2. Runge-Kuttamethods

Chapter 5: Linear Equation Systems 4 weeks

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

Evaluation method: Continuous assessment: 100%

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 : TUM 2.2
Subject 1: PWChemical Kinetics
SHV: 22h30 (PW: 1h30)
Credits : 2
Coefficient : 1

Teaching Objectives:

- Measure reaction rate from the relationship "Concentration = f(t)"
- Determine the order; Evaluate the rate constant and activation energy.
- Use linear regression to process the curves.

Recommended prerequisites:

Course content:

- Chemical method (followed by volumetric method):
- Ester saponification (ethyl acetate with sodium hydroxide): RCOOR' + NaOH = RCOONa + R'OH
- Physical method
- Polarimetry: kinetics of sucrose inversion.
- Spectrophotometry: Decomposition of a Mn3+ complex.
- Conductometric method: Ester saponification (ethyl acetate with sodium hydroxide).
- Volume measurement: Decomposition of hydrogen peroxide.

Evaluation method: Continuous assessment: 100%

Semester : 4
Teaching Unit : TUD 2.2
Subject1: Introduction to refining and petrochemistry
SHV: 22h30 (Lesson: 1h30)
Credits : 1
Coefficient : 1

Objectives of the teaching:

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 prerequisite knowledge: Organic chemistry

Course content:

Chapter 1: Formation and Exploitation of Oil and Natural Gas 4 weeks Definition and origin of petroleum, Characteristics and deposits of petroleum, Extraction techniques

Chapter 2: Petroleum Refining Schemes 6 weeks Nomenclature and characteristics of petroleum products, Major manufacturing process schemes, Environmental constraints and evolution of refining

Chapter 3: Petrochemical Manufacturing Schemes 5 weeks Diversity of products in the petrochemical industry, Major manufacturing routes in petrochemistry, Examples of processes (PVC, Ammonia)

Evaluation method: Final exam: 100%

References:

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 : TUD 2.2
Subject 1: Notions of transfer phenomena
SHV: 22h30 (Lesson: 1h30)
Credits : 1
Coefficient: 1

Aim of the subject:

-Demonstrate the balance equations for equilibrium and fluid flow. -Provide the basic concepts of heat transfer and initiate students in calculations. -Provide the basic laws describing mass transfer processes.

Recommended prerequisite knowledge: Thermodynamics and basic kinetics.

Subject content:

Chapter 1: Introduction to transfer modes 3 weeks

Chapter 2: Heat transfer Conduction, Convection, Radiation. 4 weeks

Chapter 3: Mass transfer Molecular diffusion, Convective mass transfer.4 weeks

Chapter 4: Momentum transfer Properties of fluids, Statics of fluids, General conservation equations .4 weeks

Mode of evaluation: Final exam: 100%

Refeences:
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 Génie Chimique;P.WUITHIER,1965 Edition Technip.Paris.
4-Chemical Engineering; COULSON et RICHARDSON.PergamonPress.Lim.,London1955.

Semester:4
Teaching unit: TUT2.2
Subject: Expression, information and communication Techniques
SHV:22h30 (Lesson: 1h30)
Credits:1
Coefficient:1

Objectives of the course:

This course aims to develop the student's personal and professional communication and expression skills. It also allows the student to learn about the techniques, tools, and methods used to facilitate communication.

Recommended prerequisites: Languages (Arabic, French, English)

Course content:

Chapter 1: Research, analyze and organize information (2 weeks) Identifying and using documentary resources, understanding and analyzing documents, building and updating documentation.

Chapter 2: Improve communication skills (2 weeks) Taking into account the communication situation, producing a written message, communicating orally, producing a visual and audiovisual message, improving group communication skills.

Chapter 3: Develop autonomy, organizational and communication skills in the context of a project approach (2 weeks) Situate oneself in a project and communication approach, anticipate action, implement a project: presentation of a practical work report (homework).

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

Chapter 5: Research, use, and retrieval of information. (2 weeks) Search directories (YAHOO, GOOGLE), search engines, interrogation and search language, recovery and printing of an HTML page, recovery of an image, downloading a file or software, reading a local HTML file, reading a multimedia file saved on the Web.

Chapter 6: ICT Rights (2 weeks) Computer crime, Media law, Electronic communications law, E-commerce law, Internet governance, etc.

Chapter 7: Securing sensitive information, Protecting confidential data, and Preserving nuisances. (3 weeks) Backup of important data, "Computer and Liberties" law, Internet dangers, computer hacking, machine protection, protection against viruses, protection

against online threats (phishing, spam emails, spyware, malware, ransomware, viruses and trojan horses, man-in-the-middle attacks, etc.), preventing data loss, spam, hoaxes, cryptology, electronic signature.

Assessment method: Final exam: 100%

References :

(L*ivres et polycopiés, sites internet, 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. 3- Matthieu Dubost, Améliorer son expression écrite et orale toutes les clés, Edition Ellipses 2014.
4. Allegrezza Serge et Dubrocard Anne (edited by). Internet Econometrics. Palgrave Macmillan Ltd, 2011. ISBN-10: 0230362923 ; ISBN-13: 9780230362925
5. Anduiza Eva, Jensen J. Michael et JorbaLaja (edited by). Digital Media and Political Engagement Worldwide. Cambridge UniversityPress - M.U.A, 2012. ISBN-10: 1107668492 ; ISBN-13: 9781107668492
6. Baron G.L., et Bruillard E. L'informatique et ses usagers dans l'éducation. Paris, PUF, 1996. ISBN-10: 2130474926; ISBN-13: 978-2130474920
7. En ligneChantepie P. et Le Diberder A. Révolution numérique et industries culturelles. Repères. Paris, La Découverte, 2010. ISBN-10: 2707165050; ISBN-13: 978-2707165053
8. Dawn Medlin B. Integrations of Technology Utilization and Social Dynamics in Organizations. Information Science Reference (Isr), 2012. ISBN-10: 1-4666-1948-1; ISBN-13: 978-1-4666-1948-7
9. Devauchelle B. Comment le numérique transforme les lieux de savoirs. FYP Editions, 2012. ISBN-10: 2916571612; ISBN-13: 978-2916571614
10. Greenfield David. « The Addictive Properties of Internet Usage ». In Internet Addiction, 133?153. John Wiley & Sons, Inc., 2007. ISBN: 9780470551165. http://dx.doi.org/10.1002/9781118013991.ch8.
11. Kurihara Yutaka et [Al.]. Information technology and economic development. Information Science Reference (Isr), 2007. ISBN 10: 1599045818 ; ISBN 13: 9781599045818
12. Paquelin D. L'appropriation des dispositifs numériques de formation. Du prescrit aux usages. Paris, L'Harmattan, 2009. ISBN-10: 2296085563 ; ISBN-13: 978-2296085565
13. Tansey Stephen D. Business, information technology and society. Routledge Ltd, 2002. ISBN-10: 0415192137 ; ISBN-13: 978-0415192132

Semester 5
Teaching Unit : TUF 3.1.1
Subject1: Heat Transfert
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives: -Study of the different modes of heat transfer: conduction, convection, and radiation. -Application of the laws governing these different types of heat transfer.

Recommended prior knowledge: Thermodynamics, Differential Equations.

Course 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, cases: single walls, composite walls, cylindrical layers, composite cylindrical layers (electrical analogy, overall resistance); Insulation of cylindrical layers (critical thickness of insulation); Insulation of spherical layers; General equation of conduction, fin problems.

Chapter 3: (5 weeks) Heat transfer by convection: Definitions; Expression of heat flux (Newton's law); Coefficient of heat transfer by convection, dimensional analysis, empirical correlations (natural and forced convection); Calculation of heat flux in natural convection; Calculation of heat flux in forced convection.

Chapter 4: (3 weeks) Heat transfer by radiation: Laws of radiation; Lambert's Law; Kirchhoff's Law; Radiation of blackbodies; Radiation of non-blackbodies; Reciprocal radiation of several surfaces (heat exchange by radiation between black and grey surfaces).

Assessment method: Continuous assessment: 40%; Exam: 60%

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)

Semestre :5
Teaching Unit : TUF 3.1.1
Subject2: MatterTransfer
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient : 2

Teaching Objectives: Understand the mechanisms and the formalism for describing mass transfer; Be able to write a material balance necessary for equipment calculations.

Recommended prerequisites: Thermodynamics; Chemical kinetics; Differential equations.

Course Content: Chapter 1: Mechanisms of Mass Transfer (3 weeks) Introduction; Definition of molecular diffusion; Nomenclature: mass and molar concentrations, total and individual, flux density of diffusion and transport (convection + diffusion); Definition of average mass and molar 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; Notion of effective diffusion coefficients.

Chapter 2: One-Dimensional Stationary and Quasi-Stationary Diffusion (3 weeks) Material balance-Continuity equation (global and partial); Review of gradient and divergence operators of a vector; Total mass and for a constituent i on a fixed volume element; Boundary conditions and initial condition; Examples of problems of diffusion with one variable (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: 2nd law of Fick; Instantaneous source problems (limited diffusing material quantity); Continuous source problems (fixed boundary conditions (Learn to pose a problem with its adapted equation and its initial and boundary conditions).

Chapter 4: Mass Transfer at an Interface (between phases) (4 weeks) Review of the equilibria between two phases; Theory of two films, penetration, surface renewal; Individual and global mass transfer coefficients; Notion of dimensional analysis: π-Buchingham theorem; Dimensionless numbers related to mass transfer (Sherwood, Reynolds, Schmidt); Estimation of mass transfer coefficients (dimensionless correlations).

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

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)

Semestre 5
Teaching Unit : TUF 3.1.1
Matière3: Transfer of momentum
SHV: 22h30 (Lesson: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives: To learn how to analyze typical problems encountered in fluid mechanics (statement of the problem, formulation and analytical solution); To make mass, momentum and mechanical energy balances for simple one-dimensional systems; To obtain velocity profiles and deduce other quantities of interest (flow rates, forces, pressure losses, etc.).

Recommended prerequisites: Basics in mathematics; Some knowledge in fluid mechanics.

Course content: Chapter 1: (2 weeks) Review: A- Properties of fluids, Statics of fluids, Dynamics of perfect fluids.

Chapter 2: (3 weeks) Mass, momentum and energy balances: 1. Mass conservation equation; 2. Momentum conservation equation; 3. Energy conservation equation.

Chapter 3: (5 weeks) Fluid dynamics: 1. Stress and deformation in continuous media; 2. Equations of motion for real fluids; 3. Flow regime. Applications of Navier and Stokes equations (Poiseuille flow, Couette flow, free surface flow).

Chapter 4: (2 weeks) Simple shear flow of non-Newtonian fluids, case of Bingham fluid, case of Ostwald fluid.

Chapter 5: (3 weeks) Pumps and pumping: Calculation of networks.

Assessment: Final Exam: 100%

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*.

Semestre :*5*
Teaching Unit : TUF 3.1.2
Subject1: Electrochimistry
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives: To learn how to analyze typical problems encountered in fluid mechanics (statement of the problem, formulation and analytical solution); To make mass, momentum and mechanical energy balances for simple one-dimensional systems; To obtain velocity profiles and deduce other quantities of interest (flow rates, forces, pressure losses, etc.).

Recommended prerequisites: Basics in mathematics; Some knowledge in fluid mechanics.

Course content: Chapter 1: (2 weeks) Review: A- Properties of fluids, Statics of fluids, Dynamics of perfect fluids.

Chapter 2: (3 weeks) Mass, momentum and energy balances: 1. Mass conservation equation; 2. Momentum conservation equation; 3. Energy conservation equation.

Chapter 3: (5 weeks) Fluid dynamics: 1. Stress and deformation in continuous media; 2. Equations of motion for real fluids; 3. Flow regime. Applications of Navier and Stokes equations (Poiseuille flow, Couette flow, free surface flow).

Chapter 4: (2 weeks) Simple shear flow of non-Newtonian fluids, case of Bingham fluid, case of Ostwald fluid.

Chapter 5: (3 weeks) Pumps and pumping: Calculation of networks.

Assessment: Final Exam: 100%

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.

Semestre :*5*
Teaching Unit : TUF 3.1.2
Subject2: Instrumentation– Sensors
SHV: 22h30 (Lession: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives: Acquire the knowledge necessary for mastering and exploiting the physical effects involved in instrumental devices for collecting information in measurement environments: machines, environment, etc.

Recommended prerequisites: Thermodynamics; Fluid mechanics; Transfer phenomena.

Course content: Chapter 1: (2 weeks) Measurement principles: Function of a measuring or control device; Overall structure of a measuring device; Qualities of a measuring device (zero, scale, linearity); Performance of a measuring chain.

Chapter 2: (2 weeks) Pressure measurements: Absolute and differential pressures; Vacuum; Pressure measuring devices; Use and mounting.

Chapter 3: (2 weeks) Flow measurements: Differential pressure flows, orifice flows and variable section flows; Counters.

Chapter 4: (2 weeks) Level measurements: Optical device, bubble level; Level measurement by pressure due to liquid height.

Chapter 5: (2 weeks) Temperature measurements: Thermometers and thermocouples, thermistors.

Chapter 6: (5 weeks) Sensors: Physics of sensors: Simple sensors; Transduction functions; Energy and electrical aspects; Sensor devices with multiple transductions: test bodies, acting and measured quantities; Conditioning circuits: Differential bridges, Integrated conditioners, Compensation for offsets and drifts; Applications to thermal, mechanical, electromagnetic effects and the measurement of chemical species.

Assessment method: Exam: 100%.

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.

Semestre : *5*
Teaching Unit : TUF 3.1.2
Matière 3: Chemical kenetics and Homogeneouscatalysis
SHV: 22h30 (Lesson: 1h30)
Credits : 2
Coefficient : 1

Teaching Objectives: To reinforce the basic concepts of chemical kinetics (kinetic laws: order, activation energy, rate constant) and to acquire an understanding of the treatment of reaction mechanisms. To introduce an important branch of chemical kinetics in different sectors: catalysis.

Recommended Prerequisite Knowledge: Basic principles of general chemistry (atomistic, chemical bonding, thermodynamics) and fundamental concepts of chemical kinetics.

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

Chapter 2: (4 weeks) Reaction Mechanisms: Quasi-steady state approximation; Mechanisms by stages; Chain mechanisms.

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

Chapter 4: (5 weeks) Homogeneous Catalysis: General concepts of homogeneous catalysis; Mechanisms; Acid-base catalysis; Enzymatic catalysis.

Assessment: Exam: 100%

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

Semestre : *5*
Teaching Unit : TUM 3.1
Subject1: Analysis techniques
SHV: 37h30 (Lesson: 1h30, PW: 1h00)
Credits : 3
Coefficient : 2

Objectives of the course: To learn about the main physical methods of analysis: principles, benefits, and field of application in the field of process engineering in particular. To acquire the basics of analysis and control of raw materials and formulated products.

Recommended prerequisites: Elementary notions on the wave-particle duality; Chemical bonding; Electronic transitions; Notions of analytical chemistry; Chemistry of solutions.

Course content: Chapter 1: (8 weeks) Chromatographic methods: Generalities on chromatographic methods; General principle of chromatographic separation; Liquid phase chromatography; Gas phase chromatography.

Chapter 2: (3 weeks) UV-Visible molecular spectroscopy: Principle; Theoretical notions; Apparatus; Interpretation of a UV-Visible absorption spectrum.

Chapter 3: (4 weeks) Infrared Spectroscopy (IR): Principle; Theoretical notions; Apparatus; Interpretation of an IR absorption spectrum.

Applications:

- Identification and quantification by HPLC and GC
- Verification of Beer-Lambert'slaw
- Identification of organic functions by IR.

Assessment method: Continuous assessment: 40%; Exam: 60%

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.

Semestre :*5*
Teaching Unit : TUM 3.1
Subject2: PW Physical Chemistry 1 and Chemical Engineering1
SHV: 22h30 (PW: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives: Observation of physical phenomena studied in lectures; Validating and correctly presenting obtained results; Formulating and understanding experimental techniques; Validating and correctly presenting obtained results; Communicating conclusions.

Recommended prerequisites:

- Chemistry of solutions, kinetics, basics of thermodynamics.
- Familiarity with laboratory safety rules and willingness to work in groups. Basics of thermodynamics, concepts of transfer phenomena.

Note: List for indicative purposes, subject to adjustment depending on available resources; Number of practical work sessions to be conducted = Seven (7): 4 in electrochemistry; 3 in homogeneous catalysis; 3 in heat transfer; 2 in mass transfer; 2 in Total Quality Management (TQM).

Subject matter content: Electrochemistry practical work sessions: • Dissociation constant; Weak electrolytes; Activity coefficient. • Creating an electrochemical cell. • Plotting intensity-potential curves. • Measuring voltage of a cell as a function of temperature and calculating errors. • Corrosion of a metal. • Electrolysis practical work session.

Kinetics and homogeneous catalysis practical work sessions: • Effect of catalyst nature on chemical reaction: H2O2 dismutation in presence of: iron(III) chloride, platinum wire, enzyme (piece of turnip) (Demonstrative practical work session for observing catalytic effect and distinguishing between homogeneous, heterogeneous, and enzymatic catalysis). • Determining catalytic constant of the reaction of persulfate ion with iodide ion in presence of CuSO4. • Cinetic study of the reaction of iodination (bromination) of acetone catalyzed by an acid or a base.

Chemical engineering 1 practical work sessions: • Measurement of transfer coefficient, KLa, in a mechanically stirred reactor. • Liquid diffusion. • 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 drops in pipes of different diameters. • Measurement of friction coefficient in smooth pipes. • Calibration of a measuring instrument. • Study of performance of a measuring sensor (class, reliability, accuracy, speed, etc.).

Assessment method: Continuous assessment: 100%

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.

Semestre :*5*
Teaching Unit : TUM 3.1
Subject 3 : Macroscopic balances
SHV: 37h30 (Lesson 1h30, TD: 1h00)
Credits : 3
Coefficient : 2

Content of the course: • Fundamental concepts – black box analysis Processes with **teaching objectives**: The various operations in Process Engineering require the writing of material and energy balances to control the functioning and sizing of equipment. The objectives of this course are to provide all the fundamental concepts for performing material and energy balances of a process to model the processes.

Recommended prerequisite knowledge: Physical chemistry, transfer phenomena, basic maths, and computer science.

• With or without chemical reaction • Determination of degrees of freedom • Diagram with recycling • Diagram with recycling and purging • Illustrative examples (continuous reactor, separation column, heat exchanger, cooling tower, boiler, etc.)

Assessment: Continuous assessment: 40%, Exam: 60%.

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.

Semestre :*5*
Teaching Unit : TUD 3.1
Subject 1: Pharmaceutical processes
SHV: 22h30 (Lesson: 1h30)
Credits : 1
Coefficient : 1

Course objectives: To introduce in a descriptive manner the basic concepts of synthesis processes, treatment and purification of therapeutic molecules, their shaping in galenic formulations, including the processes involved, namely: the processes and technologies related to the formulation and industrial production of drugs.

Recommended prerequisite knowledge: Basic chemistry; notions of chemical engineering.

Course content: **Chapter 1**: The drug (5 weeks) • Introduction • Definitions • The stages of drug development • Different classifications of drugs • Active principles • Excipients • Packaging • Activity and toxicity of drugs • Fate of active principles in the organism

Chapter 2: Synthesis operations (3 weeks) • Sources of active principles • Methods for obtaining natural substances • Synthetic methods • Biotechnological methods

Chapter 3: Preformulation (3 weeks) • Routes of administration • Choice of galenic forms • Biopharmaceutical classification (solubility, permeability) • Dissociation coefficient, partition coefficient

Chapter 4: Manufacturing environment (3 weeks) • Pharmaceutical company • Pharmaceutical water production • Air treatment • Notions of quality in the pharmaceutical industry

Assessment: Exam: 100%

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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

Semestre 5
Teaching Unit : TUD 3.1
Subject2: Agri-food processes
SHV: 22h30 (Lesson: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives: To introduce an important specialization in Process Engineering by presenting the specific process engineering concepts related to the agri-food industry. To provide a brief overview of the processes applied in agri-food industry.

Recommended prior knowledge: Understanding of separation techniques and transfer phenomena.

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

Chapter 2: (3 weeks) Overview of separation processes: Phase separation: Pressing; Decantation; Filtration; Centrifugation; Molecular scale separation: Extraction; Distillation; Evaporation; Entrainer processes; Membrane processes.

Chapter 3: (4 weeks) Reaction engineering: Physico-chemical reaction engineering: Coagulation, Gelation, Mixed network formation, Thermo-induced reactions; Biological reaction engineering: Biomass production, Metabolite production, Fermentation, Bioconversion.

Chapter 4: (3 weeks) Structuring operations; Emulsification; Cooking-extrusion; Foaming.

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

Assessment method: Examination: 100%

Références bibliographiques:

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.

Semestre :*5*
Teaching unit : TUT 3.1
Subject1 : Pollutions : Air, Water, Soil
SHV: 22h30 (Lesson: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives: To introduce the issues of pollution and management of our environment (causes, consequences, remedies, and the influence of environmental management); The section on "soil pollution" is designed to be accessible without prior knowledge of soil science.

Recommended prerequisite knowledge: Basic knowledge of chemistry.

Content of the course: Chapter 1: (5 weeks) Water Pollution: Water cycle; Measurement of water quality; Sources, mechanisms, and symptoms of pollution in rivers and lakes; Influence of pollution on living organisms; Oxygenation and deoxygenation; Eutrophication; Introduction to wastewater treatment and purification; Prevention of water pollution.

Chapter 2: (5 weeks) Soil Pollution: Basics of soil science; Causes and consequences of soil degradation/pollution; Behavior of trace elements in soil; Behavior of organic pollutants in soil; Risk analysis and legislation; Decontamination techniques and case studies.

Chapter 3: (5 weeks) Air Pollution: Setting the scene: Environment-Pollution-Sustainable Development-Energy-Primary energy consumption and CO2 emissions; Overview; Fundamental concepts of the atmosphere and meteorological parameters; Evolution of air quality and its effects on organisms; Chemical components of atmospheric air; Chemical pollutants; Pollution by NO2; Formation of pollutants; Some consequences of air pollution: greenhouse effect; photochemical smog; ozone hole.

Mode of evaluation: Exam: 100%.

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.

Semestre :*6*
Teaching Unit : TUF 3.2.1
Subject1: Unit Operations
SHV: 67h30 (Lesson: 3h00, TD: 1h30)
Credits : 6
Coefficient : 3

Teaching Objectives: To understand the main unit operations and to comprehend the process schemes of various process industries such as chemical, electrochemical, agro-food, pharmaceuticals, etc. and to write and verify the material balances for these processes.

Recommended prerequisite knowledge: Thermodynamics, Differential equations, Transport phenomena.

Course Content: **Chapter 1**: (1 week) Introduction to unit operations: Absorption, Extraction, Adsorption, Distillation, etc.

Chapter 2: (3 weeks) Absorption: Liquid-gas equilibrium, Isothermal absorption, Material balances, Concept of theoretical stages, McCabe and Thiele method, Notions of contactors (packed and tray columns), Hydrodynamics of flow.

Chapter 3: (4 weeks) Liquid-liquid Extraction: Introduction, Definition (solvent, solute, diluent), Equilibrium diagram, Single-stage extraction, Multistage extraction, McCabe and Thiele graphical method, Number of theoretical plates.

Chapter 4: (3 weeks) Liquid-solid extraction (Lixiviation): Solid-liquid equilibrium, Janeck diagram, Determination of the number of theoretical stages, Countercurrent and cross-current extraction cases.

Chapter 5: (4 weeks) Distillation: Distillation of a binary mixture, Batch distillation, Continuous distillation, Calculation of the efficiency of a rectification column (McCabe and Thiele and Ponchon and Savarit graphical methods).

Assessment: Continuous assessment: 40%, Exam: 60%

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.

Semestre :*6*
Teaching Unit : TUF 3.2.1
Subject 2: Thermodynamics of equilibria
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives: To master the application of the three principles of thermodynamics; To distinguish between different states of a gas; To predict the direction of evolution of a chemical reaction.

Recommended prerequisite knowledge: Chemical thermodynamics; Differential equations.

Course content: Chapter 1: Thermodynamics of solutions (2 weeks) I.1 Behavior of a component 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 arbitrary solutions with miscible and immiscible constituents; II.3 Liquid-vapor diagram at constant pressure and temperature; II.4 Application to fractional distillation and steam distillation; II.5 Extension to ternary systems.

Chapter 3: Thermodynamics of liquid-liquid and liquid-solid equilibria (5 weeks) III.1 Liquid-liquid binary mixture; III.2 Application to liquid-liquid extraction; III.3 Liquid-solid mixture; III.4 Activity and solubility diagrams; 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 a chemical reaction; IV.2 Homogeneous and heterogeneous chemical reactions; IV.3 Phase equilibria associated with a chemical reaction.

Assessment method: Continuous assessment: 40%, Examination: 60%

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 : TUF 3.2.2
Subject 1: Homogenuous reactors
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient : 2

Teaching objectives: To highlight the influence of the choice of chemical reactors and their operating conditions on the obtained reaction products. Design of ideal reactors.

Recommended prior knowledge: Thermodynamics, basic mathematics, and transfer phenomena.

Course content: Chapter 1: Stoichiometry (1 week) Notion of conversion rate; concept of advancement; single reaction case; multiple reactions case.

Chapter 2: Classification of chemical reactors (1 week) Classification of chemical reactors: perfectly stirred batch reactor (P.S.B.R); perfectly stirred continuous reactor (P.S.C.R); piston flow tubular reactor (P.F.T.R).

Chapter 3: Material balances in ideal reactors (2 weeks) Single reaction: perfectly stirred closed reactor; steady-state perfectly stirred continuous reactor; steady-state piston flow reactor.

Chapter 4: Study of homogeneous isothermal chemical reactors with a single reaction (4 weeks) 1- P.S.B.R; P.S.C.R; P.F.T.R; 2- Association of chemical reactors: Association of steady-state piston flow continuous reactors (series/parallel); Association of steady-state perfectly stirred continuous reactors (series/parallel); 3- Comparison of the performance of ideal reactors.

Chapter 5: Study of homogeneous isothermal chemical reactors with multiple reactions (4 weeks) Consecutive irreversible reactions; Competitive reactions. Selectivity and yield.

Chapter 6: Non-isothermal ideal reactors (3 weeks) Concepts of thermal balances in non-isothermal ideal reactors.

Assessment: Continuous assessment: 40%, Exam: 60%

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*
Teraching Unit : TUF 3.2.2
Subject2: Phénomènes de surface et Catalyse hétérogène
SHV: 45h00 (Lesson: 1h30, TD: 1h30)
Credits : 4
Coefficient : 2

Objectives of the course: To introduce the concept of surface tension as an essential parameter in interfacial interactions. Description of gas adsorption phenomenon on solid surfaces through thermodynamic laws. Application to the determination of surface area and porous volume of solids. To provide the basics of heterogeneous catalysis and various catalyst preparation techniques. To briefly demonstrate the complexity of catalytic reactions and the importance of kinetic modeling.

Recommended prerequisite knowledge: Mathematics, chemical kinetics, and basic thermodynamics.

Course content: Chapter 1: (3 weeks) Liquid-gas interface, Surface tension: Concept of surface tension, Thermodynamic functions, Effect of temperature, Effect of concentration, Gibbs relation, Molecular area measurement, Physicochemical study of surfactancy: Adhesion and cohesion, Wetting and contact angle.

Chapter 2: (5 weeks) Gas adsorption on solid-gas interface: Types of adsorption, Thermodynamic study, Heat of adsorption, Physisorption equilibria: Monolayer adsorption (modeling), Multilayer adsorption (modeling), Application to the determination of solid surface area, Hysteresis phenomenon, Porosity, Kelvin's law, Porous volume.

Chapter 3: (2 weeks) Chemisorption equilibria of gases: Chemisorption isotherms, Langmuir, Temkin, and Freundlich models.

Chapter 4: (2 weeks) Introduction and generalities about catalysts: Preparation methods, Characterization, Classification.

Chapter 5: (3 weeks) Kinetics of heterogeneous catalytic reactions: Mechanisms and models.

assessment: Continuous assessment: 40%, Exam: 60%

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)

Semestre :*6*
Teaching Unit : TUM 3.2
Subject 1: final cycle project
SHV: 45h00 (PW: 3h00)
Credits : 4
Coefficient : 2

Objectives of the course: To comprehensively and complementarily assimilate the knowledge from different subjects. To apply the concepts taught during the course in a concrete manner. To encourage autonomy and initiative in students. To teach students to work in a collaborative framework by fostering intellectual curiosity.

Recommended prerequisite knowledge: The entire curriculum of the undergraduate degree program.

Course content: The theme of the End-of-Cycle Project must be a concerted choice between the supervising teacher and a student (or a group of students: a pair or a trio). The subject matter must necessarily align with the objectives of the course and the student's actual abilities (undergraduate level). It is also preferable that the theme takes into account the social and economic environment of the institution. When the nature of the project requires it, it can be divided into several parts.

Note: During the weeks in which students are immersing themselves in the purpose of their project and its feasibility (literature search, research for software or materials necessary to conduct the project, revision and consolidation of teaching directly related to the subject, etc.), the course coordinator must use this present time to remind students of the essential content of the two courses "Writing Methodology" and "Presentation Methodology" covered during the first two semesters of the common core.

At the end of this study, the student must submit a written report in which he or she must clearly explain:

- A detailed presentation of the study topic, emphasizing its relevance in the socio-economic environment.
- Methods used: methodological tools, bibliographic references, contacts with professionals, etc.
- Analysis of the results obtained and their comparison with the initial objectives.
- Criticism of observed discrepancies and potential presentation of additional details.
- Identification of difficulties encountered, highlighting the limits of the work performed, and the necessary follow-up for the completed work.

The student or group of students then presents their work (in the form of a concise oral presentation or poster) to their supervising teacher and an examining teacher who can ask

questions and thus evaluate the work accomplished on both the technical and presentation aspects.

Assessment method: Continuous assessment: 100%.

Semestre :*5*
Teaching Unit : TUM 3.2
Subject2: Process simulators
SHV: 37h30 (Lesson : 1h30, TP: 1h30)
Credits : 3
Coefficient : 2

Teaching objectives:

- Familiarize with the concepts of process modeling and simulation.
- Learn about the main simulation software in process engineering.
- Learn the basics of equipment and process design using software.

Recommended prerequisite knowledge: Mathematics. Physical chemistry. Understanding of transfer phenomena.

Course content: Chapter 1: (2 weeks) Generalities: Definition of simulation; Mathematical modeling; Commercial simulators (HYSYS, Aspen, Prosim, etc.); Constituents of a process simulator; Presentation of the chosen software.

Chapter 2: (3 weeks) Getting started with the chosen software: Creating a simulation; Selection of the component list; Selection of the thermodynamic model; Getting familiar with the simulation sheet; Installation and specification of material streams.

Chapter 3: (3 weeks) Thermodynamic models of the chosen software: Equation 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; Expanders; Flash separator; Heat exchanger; Furnaces and reactors.

Chapter 5: (4 weeks) Examples of process simulation.

Evaluation method: Continuous assessment: 40%, Exam: 60%

Références bibliographiques:

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.

Semestre :*6*
Teaching Unit : TUM 3.2
Subject 3: PWPhysical chemistry 2 and chemical engineering 2
SHV: 22h30 (TP: 1h30)
Credits : 2
Coefficient : 1

Teaching objectives:

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

Recommended priorknowledge:

- Knowledge of kinetics and basic thermodynamics
- Knowledge of laboratory safety instructions and willingness to work in groups

Note: The list is indicative and may be adapted based on available resources. Number of lab sessions: eight (8) - 2 in Thermodynamics, 2 in Surface Chemistry, 4 in Chemical Engineering.

Course content: Lab Session 1: Thermodynamics

- Determination of heat of solution
- 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 equilibrium, liquid-liquid equilibrium
- Heat of ionicreaction
- Determination of partial molar volumes of a binary solution
- Diagram of a ternary mixture

Lab Session 2: 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

Lab Session 3: Chemical Engineering

- Batch distillation
- Continuous distillation of ethanol/water mixture
- Simple distillation
- Solvent extraction
- Partition coefficient

Assessment: Continuous assessment: 100%

Semester :*6*
Teaching Unit : TUD 3.2
Subject 1 : Cryogenic processes
SHV: 22h30 (Lesson: 1h30)
Credits : 1
Coefficient : 1

Teaching objectives: Present the different processes in the field of refrigeration and cryogenics; Some applications in the field of low temperatures.

Recommended prerequisite knowledge: Heat transfer phenomena; Thermodynamics and mathematical tools (differential equations and integral calculus).

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

Chapter 2: (4 weeks) Separation and purification processes of cryogenic fluids: Separation process: ideal system; Separation processes - Rectification; Role and description of the Joule-Thomson valve; Separation processes of air.

Chapter 3: (5 weeks) Liquefaction processes of permanent gases: Linde-Hampson liquefaction process; Double compression Linde-Hampson liquefaction process; Claude liquefaction process.

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

Evaluation method: Exam: 100%

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 : TUD 3.2
Subject 2 : Corrosion
SHV: 22h30 (Lesson: 1h30)
Credits : 1
Coefficient : 1

Course Objectives: To introduce the phenomenon of corrosion, provide theoretical foundations, and present various techniques for protecting against corrosion.

Recommended Prerequisite Knowledge: Basics of electrochemistry, surface phenomena.

Course Content: Chapter 1: (6 weeks) Different types of corrosion: Electrochemical corrosion: Generalized corrosion (uniform and galvanic), localized corrosion, stress corrosion cracking, 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.

Assessment: Exam: 100%.

Regenerateresponse

Références bibliographiques:

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
Subject : Entrepreneurship and companymanagement
SHV : 22h30 (Cours : 1h30)
Credits : 1
Coefficient : 1

Objectives of the course:

- Prepare students for their professional integration at the end of their studies;
- Develop entrepreneurial skills among students;
- Sensitize students to and familiarize them with the possibilities, challenges, procedures, characteristics, attitudes, and skills required for entrepreneurship;
- Prepare students to eventually create their own business or at least better understand their work in a small or medium-sized enterprise (SME).

Recommended prior knowledge:

No specific knowledge, except for fluency in the language of instruction.

Skills targeted:

The course aims to develop students' abilities to analyze, synthesize, work in a team, communicate well orally and in writing, be autonomous, plan and meet deadlines, and be reactive and proactive. Students will also be sensitized to entrepreneurship through the presentation of an overview of management knowledge useful for creating activities.

Course content:

Chapter 1 - Operational preparation for employment: (2 weeks) Writing a cover letter and CV, job interviews, research on jobs in the field, conducting interviews with professionals, and simulating job interviews.

Chapter 2 - Entrepreneurship and entrepreneurial spirit: (2 weeks) Entrepreneurship, companies around you, entrepreneurial motivation, setting goals, and taking risks.

Chapter 3 - The profile of an entrepreneur and the profession of entrepreneurship: (3 weeks) Entrepreneurial qualities, negotiation skills, listening skills, the place of SMEs in Algeria, and the main factors of success in creating a small or medium-sized enterprise (SME).

Chapter 4 - Finding a good business idea: (2 weeks) Creativity and innovation, recognizing and evaluating business opportunities.

Chapter 5 - Launching and operating a business: (3 weeks) Choosing an appropriate market, location, legal forms of the enterprise, seeking help and financing to start a business, recruiting personnel, and selecting suppliers.

Chapter 6 - Developing a business project: (3 weeks) The Business Model and Business Plan, realizing the business project with the Business Model Canvas.

Assessment method: Exam: 100%.

References :

- FayolleAlain, 2017. Entrepreneuriat théories et pratiques, applications pour apprendre à entreprendre.Dunod, 3e éd.

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

- PlaneJean-Michel, 2016, Management des organisations théories, concepts, performances. Dunod, 4ème éd.

- LégerJarniou, Catherine, 2017, Construire son Business Plan. Le grand livre de l'entrepreneur. Dunod,.

- Sion Michel, 2016, Réussir son business Méthodes, outils et astuces plan.Dunod ,4èmeéd.

- Patrick Koenblit, Carole Nicolas, Hélène Lehongre, Construire son projet professionnel, ESF, Editeur 2011.

- Lucie Beauchesne, Anne Riberolles, Bâtir son projet professionnel, L'Etudiant 2002.

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

IV- *Agreements / Conventions*

LETTER OF INTENT TEMPLATE

(In case of joint degree with another university)

(Official letterhead of the concerned university)

Subject: Approval of the joint degree program titled:

By this letter, the University (or the University Center) hereby declares its joint sponsorship of the aforementioned degree program throughout the period of its accreditation.

To this end, the University (or the University Center) will assist in this project by:

- Providing its opinion in the development and updating of the educational programs,
- Participating in seminars organized for this purpose,
- Participating in the thesis committees,
- Working towards the sharing of human and material resources.

SIGNATURE of the legally authorized person:

POSITION:

Date:

LETTER OF INTENT TEMPLATE

(In the case of a degree program in collaboration with a user company)

(Official letterhead of the company)

SUBJECT: Approval of the project to launch a degree program entitled:

Offered at:

Hereby, the company declares its willingness to show support for this degree program as a potential user of the product.

To this end, we confirm our membership in this project and our role will consist of:

- Providing our point of view in the development and updating of the teaching programs,
- Participating in seminars organized for this purpose,
- Participating in the defense juries,
- Facilitating, as much as possible, the reception of trainees either within the framework of end-of-studies dissertations or within the framework of tutored projects.

The necessary means to carry out the tasks incumbent upon us for the achievement of these objectives will be implemented in terms of materials and human resources.

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

SIGNATURE of the person legally authorized:

POSITION:

Date:

OFFICIAL STAMP or SEAL OF THE COMPANY

V-Opinions and Visas from Administrative and Advisory Bodies

Degree Program Title: Process Engineering

Department Head + Domain Team Manager
Date and visa:
Faculty Dean (or Institute Director)
Date and visa:

University Establishment Head
Date and visa:

VI – VI - Opinion and Visa from the Regional Conference

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