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

جامعة محمد خيضر
بسكرة
Mohamed Khider University of Biskra

TRAINING OFFER
LMD

ACADEMIC LICENSE

NATIONAL PROGRAM
2021–2022
(2nd update)

Establishment	Faculty / Institute	Department
Mohamed Khider University of Biskra	***Faculty of Science and Technology***	***Mechanical Engineering***

Domain	Sector	Speciality
Science And Technologies	***Metallurgy***	***Metallurgy***

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

عرض تكوين
ل. م. د
ليسانس أكاديمية

برنامج وطني
2021 – 2022

المؤسسة	الكلية/ المعهد	القسم
جامعة محمد خيضر بسكرة	كلية العلوم والتكنولوجيا	الهندسة الميكانيكية

الميدان	الفرع	التخصص
علوم و تكنولوجيا	تعدين	تعدين

Summary

I – License identity sheet

1 - Location of the training :

Faculty (or Institute):

Department :

References of the authorisation order (attach copy of the order)

2- External partners :

Other partner establishments:

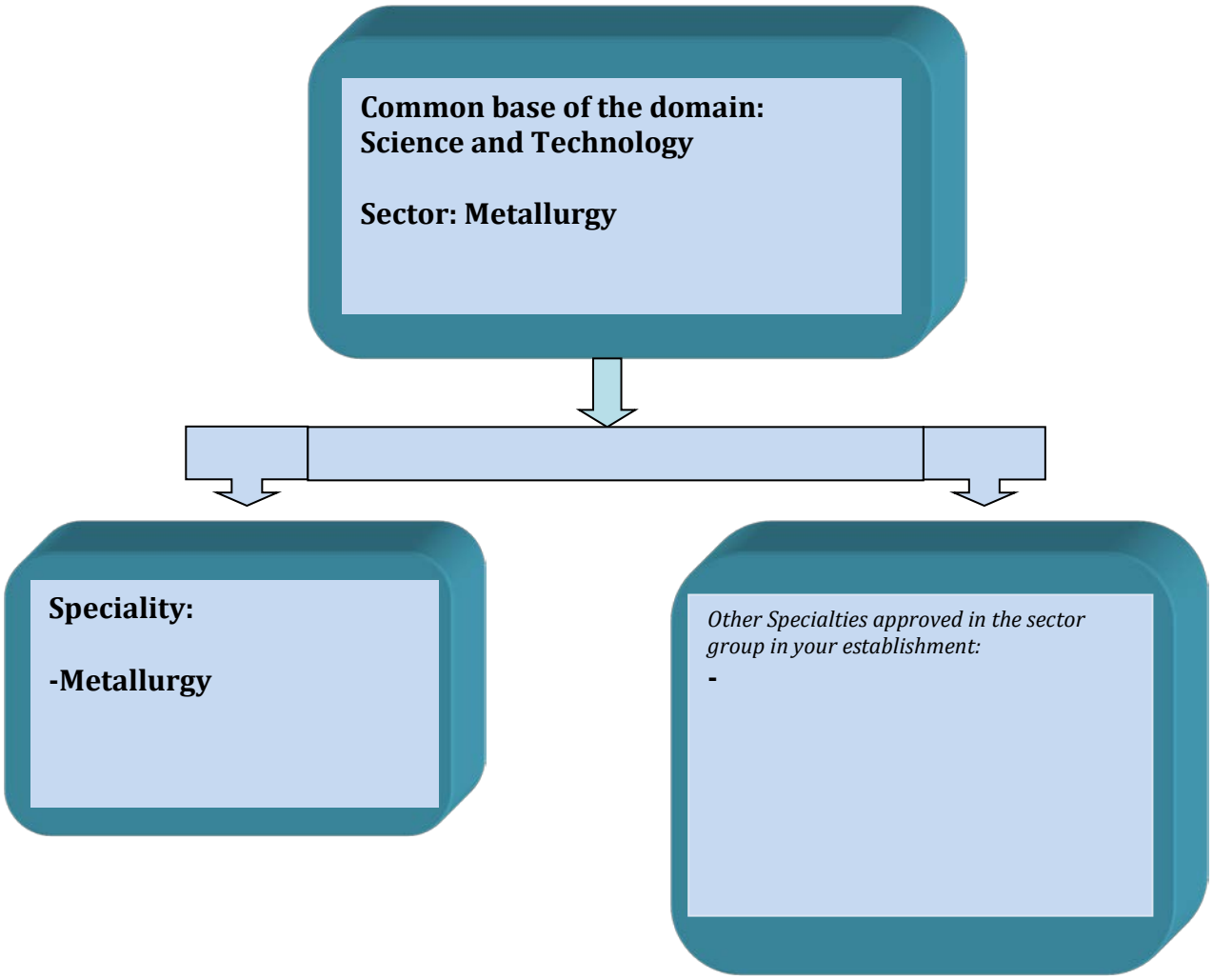
Businesses and other socio-economic partners:

International partners:

3– Context and objectives of the training

A – General organization of training : project position

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



B - Training objectives :

The metallurgy license crowns training spread over six semesters. The first two semesters represent the common core of the Science and Technology field, followed by two semesters in the metallurgy sector. These first four semesters focus on fundamental training in sciences such as mathematics, **Physical metallurgy** s, chemistry, thermodynamics, mechanics and some metallurgy subjects. The last two semesters include subjects which constitute the essential basic knowledge for any metallurgist.

This license being of an academic type, it offers a course allowing students to acquire basic knowledge which will allow them either to pursue master's studies in different metallurgy options, or to integrate into the world of work in fields such as the steel industry, foundry, mechanical engineering, automobile industry, shipbuilding, construction materials…

C – Targeted profiles and skills:

At the end of his training, the student is supposed to have assimilated and mastered the basic notions of metallurgy such as phase transformations, the physico-chemistry of metal production, their structures and characteristics, their heat treatments, their formatted, their damage and the means of their protection.

He must, among other things, be able to:

- Identify steel or any other metal according to its destination; develop it, format it and process it.
- Characterize a metal or alloy and assign it an identity (shade).
- Modeling a steelmaking process
- Approach a preliminary project and analyze a problem in the field of metallurgy
- Recommend one metal over another for a specific use.

D – Regional and national employability potential:

Algeria has a very significant industrial base. The sector requiring metallurgists whose profile is covered by this license is difficult to list but it can be cited as an example and depending on the size of the companies:

Very large companies:

- The El Hadjar steel complex;
- Sonatrach;
- ANABIB and its subsidiaries;
- SONACOM (Industrial vehicle production company);
- PMA (Agricultural Machinery Production Company);
- Military industry;
- Cables.

SMEs and SMIs:

- The field of construction materials;
- The metal processing industry;
- Metal recycling;
- Shaping of metals.

E – Gateways to other specialties :

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

Table of sectors and specialties in the Science and Technology field

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

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

Group of sectors C Semester 3 common	
Sector	**Specialties**
Process Engineering	Process Engineering
Mining engineering	Mining
	Valorization of mineral resources
Hydrocarbons	Hydrocarbons
Industrial hygiene and safety	Industrial hygiene and safety
Petrochemical industries	Refining and petrochemicals

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

This license offers multidisciplinary and transversal teaching programs: Multidisciplinary, in the sense that the teaching in this specialty is 100% identical for semesters 1 and 2 with all the specialties in the Science and Technology field. On the other hand, the lessons of semester 3 for all the specialties of the same group of sectors are also 100% identical.

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

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

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

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

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

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

F – Expected training performance indicators:

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

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

1. Evaluation of the course of the training:

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

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

Before the training:

- ✓ Evolution of the rate of students who have chosen this License (supply/demand RATIO) .
- ✓ Rate and quality of students who choose this license.

During training:

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

After the training:

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

2. Evaluation of the course of lessons:

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

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

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

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

3. Integration of graduates:

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

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

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

G1- Evaluation by continuous monitoring:

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

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

combined with the proposals emanating from several establishments, resulted in the recommendations below.

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

1. Proposals relating to subjects with guided work:

1.1. Preparing the series of exercises:

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

1.2. Written questions :

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

1.3. Student participation in tutorials:

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

1.4. Student Attendance:

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

2. Case of methodological units (Practical work):

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

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

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

However, the teacher in charge of this subject can, if he wishes, let the students know that he can possibly evaluate them (ongoing) by offering to prepare presentations, make reports, look for additional information. of the course, use free software, ask students to watch at home a popular science film related to the subject (after having given them either the film on electronic media or having indicated to them the internet link to this film) and ask them to then submit a written report or make an oral presentation of the summary of this film, etc. The improvement of these activities is left to the discretion of the teacher and the training team who are the only ones able to define the best way to take this personal work into account in the overall mark of the final exam.

In the same vein, and in the case where the number of students in this subject is reasonable (20 to 30 students), which may be the case for many masters, the person responsible for the subject may consider continuous evaluations of the student like what is done in subjects with tutorials. The only obligation to respect is that students should be informed of this procedure and validated during the first Teaching Council.

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

4. Harmonization of continuous monitoring:

The use of a common grid for evaluation would promote the harmonization of these practices from one teacher to another, from one department to another and from one establishment to another. It would also constitute a structuring and reassuring benchmark for students. To do this, we propose below an evaluation grid for information purposes which presents the various continuous controls making it possible to evaluate the degree of acquisition of students' skills, whether in terms of knowledge or analytical skills. and synthesis skills.
Please note that these assessments are not intended to “trap” students by imposing very difficult continuous assessments on them. On the contrary, it is a question of 'honestly' evaluating the degree of assimilation of the different skills and knowledge taught to the student in complete objectivity. In the same spirit, we would benefit from promoting the contractualization of learning evaluation by specifying, for example, the success criteria and good practices which would result in correct and precise answers to the questions. Thus, the evaluation would mainly focus on the acquired knowledge which was the subject of training by giving exercises linked to what was prepared in tutorial without forgetting, however, to evaluate the students' ability to mobilize their skills in more complex situations.

4-1 Directed work:

Preparation of series of exercises and personal work (homework, presentations, etc.)	30%	06 points
Written questions (minimum 02 questions including one proposed by the subject	50%	10 points

manager)		
Student participation in tutorials	20%	04 points
Total	**100%**	**20 points**

4.2 Practical work:

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

G2- Student's personal work :

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

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

1. Homework :

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

2. Mini course project:

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

The theme of the mini course project must be well targeted and decided by the teacher for a group of students (2 to 5 maximum), sanctioned by a single report (10 pages maximum) and a short collective oral presentation (preferably with audio-visual support). A mark, common for

the group, is awarded according to an evaluation grid (presentation of the document and use of bibliographic resources, oral presentation, respect for time, answers to questions, etc.) and will then be counted, as a bonus, in the continuous monitoring score.

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

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

4 . Participation in scientific events:

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

5. Use of New Information and Communication Technologies:

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

Conclusion :

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

4 - Human resources available :

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

Number of students:

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

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

Visa from the department

Visa from the faculty or institute

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

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

Visa from the department **Visa from the faculty or institute**

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

Grade	Internal Workforce	External Workforce	Total
Professors			
Associate Professors (A)			
Associate Professors (B)			
Assistant Professor (A)			
Assistant Professor (B)			
Other (*)			
Total			

(*) Technical and support staff

5 - Material resources specific to the specialty

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

Laboratory title:

Student capacity:

No.	Equipment designation	Number	Comments

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

Training place	Number of students	Training period

C- Documentation available at the establishment level specific to the training offered (Mandatory field):

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

II – Half-yearly teaching organization sheets of the specialty

Semester 3

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**tutorials**	**PW**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 2.1.1 Credits: 10 Coefficients: 5	Mathematics 3	6	3	3h00	1h30		67h30	82h30	40%	60%
	Waves and vibrations	4	2	1h30	1h30		45:00	55h00	40%	60%
Fundamental EU Code: UEF 2.1.2 Credits: 8 Coefficients: 4	Fluid mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Rational mechanics	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological EU Code: UEM 2.1 Credits: 9 Coefficients: 5	Probability and statistics	4	2	1h30	1h30		45h00	55h00	40%	60%
	Computer science 3	2	1			1h30	10h30	27h30	100%	
	Technical drawing	2	1			1h30	10h30	27h30	100%	
	TP Waves and vibrations	1	1			1h00	3h00	10h00	100%	
EU Discovery Code: UED 2.1 Credits: 2 Coefficients: 2	Core technology	1	1	1h30			10h30	02h30		100%
	Metrology	1	1	1h30			10h30	02:30		100%
Transversal EU Code: UET 2.1 Credits: 1 Coefficients: 1	Technical English	1	1	1h30			10h30	02h30		100%

Total semester 3		**30**	**17**	**1h30**	**7h30**	**4h00**	**375h00**	**375h00**		

Semester 4

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**tutorials**	**PW**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 2.2.1 Credits: 6 Coefficients: 3	Physical chemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
	Mineralogy and crystallography	2	1	1h30			10h30	27h30		100%
Fundamental EU Code: UEF 2.2.2 Credits: 8 Coefficients: 4	Mathematics 4	4	2	1h30	1h30		45h00	55h00	40%	60%
	Numerical methods	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 2.2.3 Credits: 4 Coefficients: 2	Strength of materials	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological EU Code: UEM 2.2 Credits: 9 Coefficients: 5	Physical Chemistry TP	2	1			1h30	10h30	27h30	100%	
	Mineralogy TP and crystallography	2	1			1h30	10h30	27h30	100%	
	Computer Assisted drawing	2	1			1h30	10h30	27h30	100%	
	TP Numerical methods	2	1			1h30	10h30	27h30	100%	
	TP Resistance of materials	1	1			1h00	3h00	1000	100%	
EU Discovery Code: UED 2.2 Credits: 2 Coefficients: 2	Material properties	1	1	1h30			10h30	02h30		100%
	Extractive Metallurgy	1	1	1h30			10h30	02h30		100%
Transversal EU Code: UET 2.2 Credits: 1coeff 1	Expression, information and communication	1	1	1h30			10h30	02h30		100%

	techniques									
Total semester 4		**30**	**17**	**12h00**	**6h00**	**7h00**	**375h00**	**375h00**		

Semester 5

Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**tutorials**	**PW**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 3.1.1 Credits: 10 Coefficients: 5	Physical metallurgy 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Heat and mass transfer	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental EU Code: UEF 3.1.2 Credits: 8 Coefficients: 4	Elaboration of ferrous metals	4	2	3h00			45h00	55h00		100%
	Mechanical behavior of metals and alloys	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological EU Code: UEM 3.1 Credits: 9 Coefficients: 5	TP Heat transfer and mass	2	1			1h30	10h30	27h30	100%	
	Pw Metallurgy physics 1	4	2			3h00	45h00	55h00	100%	
	Analysis and characterization methods	3	2	1h30		1h00	37h30	37h30	40%	60%

EU Discovery Code: UED 3.1 Credits: 2 Coefficients: 2	Non-metallic materials	1	1	1h30			10h30	02h30		100%
	Standardization in metallurgy	1	1	1h30			10h30	02h30		100%
Transversal EU Code: UET 3.1 Credits: 1 Coefficients: 1	Industrial electricity	1	1	1h30			10h30	02h30		100%
Total semester 5		**30**	**17**	**3h00**	**4h30**	**5h30**	**375h00**	**375h00**		

Semester 6

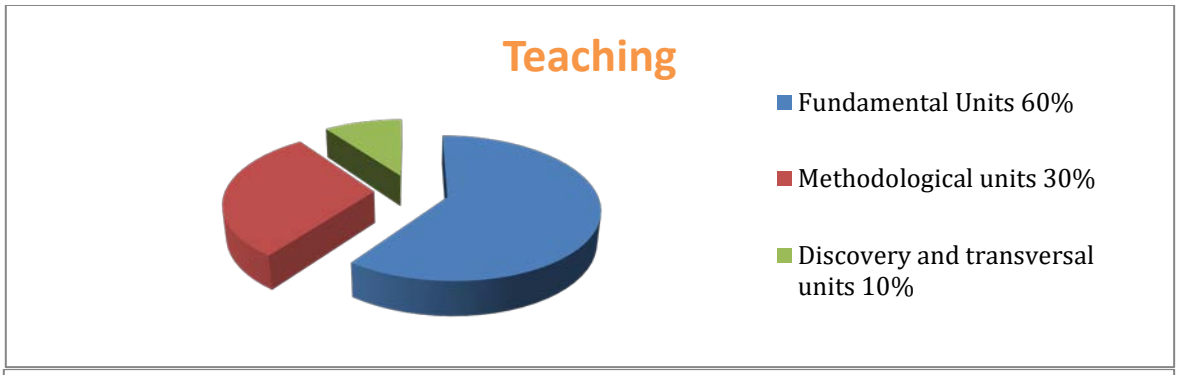
Teaching unit	Materials	Credits	Coefficient	Weekly hourly volume			Half-yearly Hourly Volume (15 weeks)	Additional Work in Consultation (15 weeks)	Evaluation mode	
	Titled			**Course**	**tutorials**	**PW**			**Continuous monitoring**	**Exam**
Fundamental EU Code: UEF 3.2.1 Credits: 12 Coefficients: 6	Physical metallurgy 2	6	3	3h00	1h30		67h00	82h30	40%	60%
	Corrosion and protection of metals	6	3	3h00	1h30		67h00	82h30	40%	60%
Fundamental EU Code: UEF 3.2.2 Credits: 6 Coefficients: 3	Special steels and alloys	4	2	**3h00**			45h00	55h00		100%
	Metal Forming Processes	2	1	1h30			10h:30	27h30		100%
Methodological EU Code: UEM 3.2 Credits: 9 Coefficients: 5	End of Cycle Project	4	2			3h00	45h00	55h00	100%	
	TP Metal Forming Processes	2	1			1h30	10h30	27h30	100%	
	Practical thermal and thermochemical treatments of metals	3	2			2h30	37h30	37h30	100%	
EU Discovery Code: UED 3.2 Credits: 2 Coefficients: 2	Concepts of measurements and instrumentation	1	1	1h30			10h30	02h30		100%
	Safety and environment	1	1	1h30			10h30	02h30		100%
Transversal EU Code: UET 3.2	Entrepreneurship and business management	1	1	1h30			10h30	02h30		100%

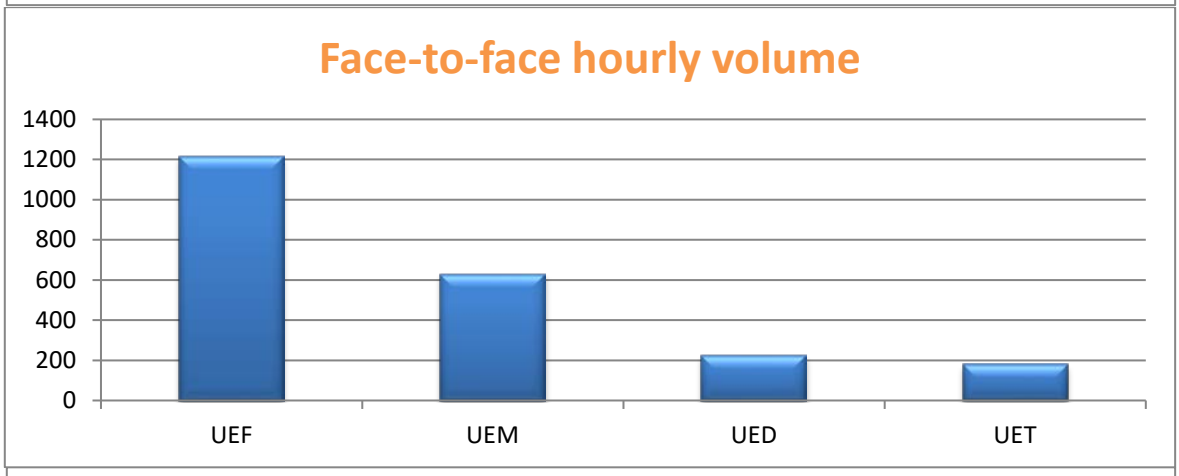
Credits: 1 Coefficients: 1										
Total semester 6		**30**	**17**	**3h00**	**3h00**	**7h00**	**375h00**	**375h00**		

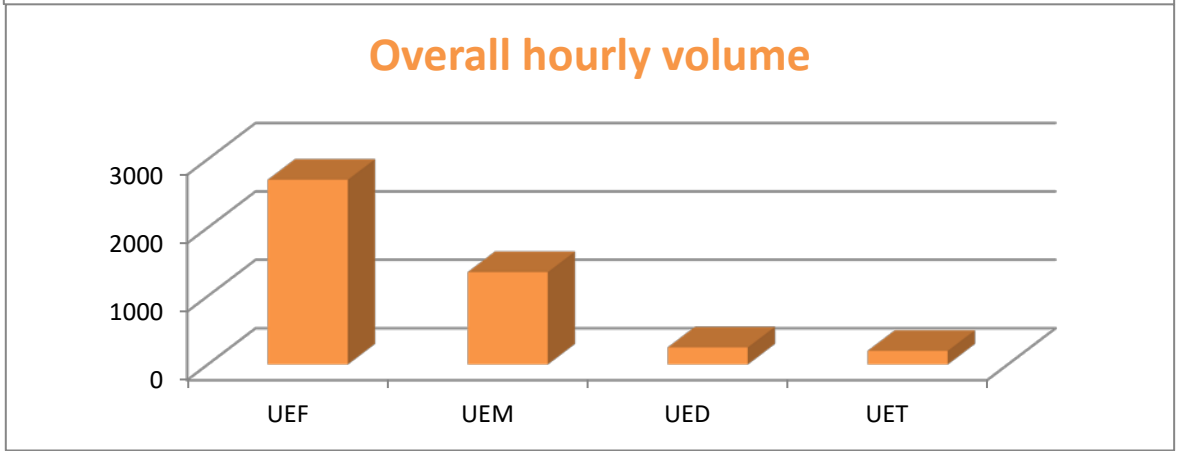
The evaluation methods presented in these tables are given for information purposes only; the establishment's training team may suggest other weightings.

Overall summary of the training:

EU / V.H.	UEF	EMU	UED	UET	Total
Course	787h30	120h00	225h00	180h00	1312h30
tutorials	427h30	10h30	---	---	450h00
PW	---	487h30	---	---	487h30
Personal work	1485h00	720h00	25h00	8h00	2250h00
other (explain, list,)	---	---	---	---	---
Total	2700h00	1350h00	250h00	200h00	4500h00
Credits	108	54	10	8	180
% in credits for each EU	60%	30 %	10%		100%







III - Detailed program by subject

Semester: 3
Teaching unit: UEF 2.1.1
Subject 1: Mathematics 3
VHS: 67h30 (Course: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

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

Recommended prior knowledge

Mathematics 1 and Mathematics 2

Content of the material:

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

1.1 Reminders on the Riemann integral and on the calculation of primitives. 1.2 Double and triple integrals.
1.3 Application to the calculation of areas, volumes, etc.

Chapter 2: Improper integrals **2 weeks**

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

Chapter 3: Differential equations **2 weeks**

3.1 Reminder of ordinary differential equations. 3.2 Partial differential equations. 3.3 Special functions.

Chapter 4: series **3-week**

4.1 Numerical series. 4.2 Sequences and series of functions. 4.3 Integer series, Fourier series.

Chapter 5: Fourier Transformation **3 weeks**

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

Chapter 6: Laplace transformation **2 weeks**

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

Evaluation method:

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

Bibliographic references:

1- F. Ayres Jr, Theory and Applications of Differential and Integral Calculus - 1175 corrected exercises, McGraw-Hill.
2- F. Ayres Jr, Theory and Applications of Differential Equations - 560 corrected exercises, McGraw-Hill.
3- J. Lelong-Ferrand, JM Arnaudiès, Mathematics Course - Differential Equations, Multiple Integrals, Volume 4, Dunod University.
4- M. Krasnov, Collection of problems on ordinary differential equations, Moscow Edition
5- N. Piskounov, Differential and integral calculus, Volume 1, Moscow edition
6- J. Quinet, Elementary course of higher mathematics 3- Integral calculation and series, Dunod.
7- J. Quinet, Elementary course of higher mathematics 4- Differential equations, Dunod.
8- MR Spiegel, Laplace Transforms, Courses and problems, 450 Corrected exercises, McGraw-Hill.

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

Teaching objectives

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

Recommended prior knowledge

Mathematics 2, Physics 1 and Physics 2

Content of the material :

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

Part A: Vibration

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

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

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

2.1 Undamped oscillations
2.2 Free oscillations of damped systems

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

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

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

4.1 Introduction
4.2 Systems with two degrees of freedom

Chapter 5: Forced oscillations of systems with two degrees of freedom 2 weeks
5.1 Lagrange equations
5.2 Mass-spring-damper system
5.3 Impedance
5.4 Applications
5.5 Generalization to systems with n degrees of freedom

Part B: Waves
Chapter 1: One-dimensional propagation phenomena 2 weeks
1.1 General and basic definitions
1.2 Propagation equation
1.3 Solution of the propagation equation
1.4 Sinusoidal traveling wave
1.5 Superposition of two progressive sinusoidal waves

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

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

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

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

Bibliographic references :

1. H. Djelouah; Vibrations and Mechanical Waves – Courses & Exercises (USTHB University website: perso.usthb.dz/~hdjelouah/Coursvom.html)
2. T. Becherrawy; Vibrations, waves and optics; Hermes science Lavoisier, 2010
3. J. Brac; Propagation of acoustic and elastic waves; Hermès science Publ. Lavoisier, 2003.
4. R. Lefort; Waves and Vibrations; Dunod, 2017
5. J. Bruneaux; Vibrations, waves; Ellipses, 2008.
6. J.-P. Perez, R. Carles, R. Fleckinger; Electromagnetism Foundations and Applications, Ed. Dunod, 2011.
1. H. Djelouah; Electromagnetism ; Office of University Publications, 2011.

Semester : *3*
Teaching unit: UEF 2.1.2
Subject 1: Fluid mechanics
VHS: 45h00 (Course: 1h30; Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objective:

Introduce the student to the field of fluid mechanics, fluid statics will be detailed in the first part. Then in the second part, the study of the movement of inviscid fluids will be considered at the end it is the movement of the real fluid, which will be studied.

Recommended prior knowledge:

Chapter 1: Properties of fluids **3 weeks**

1. Physical definition of a fluid: States of matter, divided matter (dispersion suspensions, emulsions)
2. Perfect fluid, real fluid, compressible fluid and incompressible fluid.
3. Density, density
4. Rheology of a fluid, Viscosity of fluids, surface tension of a fluid

Chapter 2: Fluid Statics **4 weeks**

1. Definition of pressure, pressure at a point of a fluid
2. Fundamental law of fluid statics
3. Level surface
4. Pascal's theorem
5. Calculation of pressure forces: Flat plate (horizontal, vertical, oblique), center of thrust, static pressure measuring instruments, pressure measurement atmospheric, barometer, Torricelli's law
2. Pressure for superimposed immiscible fluids

Chapter 3 Dynamics of perfect incompressible fluids **4 weeks**

1. Permanent flow
2. Continuity equation
3. Mass flow and volume flow
4. Bernouilli's theorem, cases without work exchange and with work exchange
5. Applications to flow and speed measurements: Venturi, Diaphragms, tubes Pitot...
6. Euler's theorem

Chapter 4: Dynamics of real incompressible fluids **4 weeks**

1. Flow regimes, Reynolds experiment
2. Dimensional analysis, Vashy-Buckingham theorem, Reynolds number
3. Linear pressure losses and singular pressure losses, Moody diagram.
4. Generalization of Bernouilli's theorem to real fluids

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

Bibliographic references:

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

1- Fundamentals of fluid mechanics 6 th Edition, 2009, BR Munson, DF Young THOkiishi, WW Huebsch 6 th Edition John Wiley & Sons
2- Fluid mechanics , YA Cengel - 2010 - Tata McGraw-Hill Education
3- Fluid Mechanics Frank M. White Fourth Edition 2003 McGraw-Hill
4- Fluid mechanics and hydraulics 2nd edition, Ronald v. Giles, Jack B Evett, Cheng Liu, McGraw-Hill
5- S. Amiroudine , JL Battaglia , ' Fluid Mechanics Course and Corrected Exercises'Ed. Dunod
6- R. Comolet, 'Experimental fluid mechanics', Volume 1, 2 and 3, Ed. Masson et Cie.
7- R. Ouziaux, 'Applied fluid mechanics', Ed. Dunod, 1978
8- BR Munson, DF Young, TH Okiishi, 'Fundamentals of fluid mechanics', Wiley & sons. RV Gilles, 'Fluid mechanics and hydraulics: Courses and problems', Schaum Series, Mc Graw Hill, 1975.

Semester: 3
Teaching unit: UEF 2.1.2
Subject 2: Rational mechanics
VHS: 45h00 (Course: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

The student will be able to understand the nature of a problem (static, kinematic or dynamic) in solid mechanics; he will have the tools allowing him to solve the problem within the framework of classical mechanics. This subject constitutes a prerequisite for the subjects RDM and analytical mechanics.

Recommended prior knowledge

The student must first assimilate the physics subject 1, which deals with the mechanics of the point. In addition, mathematics subject 2 includes essential tools.

Content of the material:

Chapter 1: Mathematical reminders (elements of vector calculation). 1 week

Chapter 2: General and basic definitions 2 weeks

2.1 Definition and physical meaning of force
2.2 Mathematical representation of force
2.3 Force operations (composition, decomposition, projection)
2.4 Type of force: point, linear, surface, volume
2.5 Classification of forces: internal forces, external forces.
2.6 Mechanical models: the material point, the solid body

Chapter 3: Static. 3 weeks

3.1 Axioms of statics
3.2 Connections, supports and reactions
3.3 Axiom of connections
3.4 Equilibrium conditions:
3.4.1 Contributing forces
3.4.2 Parallel forces
3.4.3 Plane forces

Chapter 4: kinematics of the rigid solid. 3 weeks

4.1 Brief reminders of the kinematic quantities for a material point.
4.2 Solid body kinematics
4.2.1 Translation movement
4.2.2 Rotational movement around a fixed axis
4.2.3 Plane movement
4.2.4 Compound movement.

Chapter 5: Mass geometry. 3 weeks

5.1 Mass of a hardware system

5.1.1 Continuous system
5.1.2. Discreet system
5.2 Integral formulation of the center of mass
5.2.1. Definitions (linear, surface and volume cases)
5.2.2 Discrete formulation of the center of mass
5.2.3 GULDIN theorems
5.3. Moment and product of inertia of solids
5.4. Inertia tensor of a solid
5.4.1 Special cases
5.42 Main axes of inertia
5.5. Huyghens' theorem
5.6. Moment of inertia of solids relative to any axis.

Chapter 6: Dynamics of the rigid solid. **3 weeks**

6.1 Brief reminders of dynamic quantities for a material point.
6.2 Element of rigid body kinetics:
6.2.1 Quantity of movement
6.2.2 Angular momentum
6.2.3 Kinetic energy
6.3 Dynamics equation for a solid body
6.4 Angular momentum theorem
6.5 Kinetic energy theorem
6.6 Applications:
6.6.1 Case of pure translation
6.6.2 Case of rotation around a fixed axis
6.6.3 Combined case of translation and rotation.

Evaluation method: continuous assessment: 40%; Final exam: 60%.

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

1. Elements of Rational Mechanics. S.Targ. Mir Moscow Editions
2. Mechanics for the use of engineers. STATIC. Russell Publishing. Ferdinand P. Beer
3. General mechanics. Courses and corrected exercises. Sylvie Pommier. Yves Berthaud. DUNOD.
4. General mechanics - Theory and application, Serial editions. MURAY R. SPIEGEL schaum, 367p.
5. General mechanics – Exercises and solved problems with course reminders, Office of University Publications, Tahar HANI 1983, 386p.

Semester: *3*
Teaching unit: UEM 2.1
Subject 1: Probability & Statistics
VHS: 45h00 (Course: 1h30; Tutorial: 1h30)
Credits: 4
Coefficient: 2

Objectives of the subject

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

Recommended prior knowledge

Mathematics 1 and Mathematics 2

Material content:

Part A: Statistics

Chapter 1: Basic definitions (1 week)

1. Concepts of population, sample, variables, modalities
2. Different types of statistical variables: qualitative, quantitative, discrete, and continuous.

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

1. Number, Frequency, Percentage.
2. Cumulative number, Cumulative frequency.
3. Graphical representations: bar chart, circular chart, bar chart. Polygon of numbers (and frequencies). Histogram. Cumulative curves.
4. Position characteristics
5. Dispersion characteristics: extent, variance and standard deviation, coefficient of variation.
6. Shape characteristics.

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

1. Data tables (contingency table). A cloud of dots.
2. Marginal and conditional distributions. Covariance.
3. Linear correlation coefficient. Regression line and Mayer line
4. Regression curves, regression corridor and correlation ratio.
5. Functional fit.

Part B: Probabilities

Chapter 1: Combinatorial Analysis (1 week)

1. Arrangements
2. Combinations
3. Permutations.

Chapter 2: Introduction to Probability (2 weeks)

1. Algebra of events
2. Definitions
3. Parabolized spaces
4. General probability theorems

Chapter 3: Conditioning and independence (1 week)

1. Packaging,
2. Independence,
3. Bayes formula**.**

Chapter 4: Random variables (1 week)

1. Definitions and properties,
2. Distribution function,
3. Mathematical expectation,
4. Covariance and moments.

Chapter 5: Usual discrete and continuous probability laws3 weeks

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

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

Bibliographic references:

1. D. Dacunha-Castelle and M. Duflo. Probability and statistics: Fixed-time problems. Masson, 1982.
2. J.-F. Delmas. Introduction to probability calculation and statistics. Handout ENSTA, 2008.
3. W. Feller. an Introduction to Probability Theory and its Applications, Volume 1. Wiley & Sons, Inc., 3rd edition, 1968.
4. G. Grimmett, D. Stirzaker, Probability and Random Processes, Oxford University Press, 2nd edition, 1992.
5. J. Jacod and P. Protter, Probability Essentials, Springer, 2000.
6. A. Montfort. Mathematical statistics course. Economica, 1988.
7. A. Montfort. Introduction to statistics. Polytechnic School, 1991

Semester: *3*
Teaching unit: UEM 2.1
Subject 1: Computer Science 3
VHS: 10h30 (PW: 1h30)
Credits: 2
Coefficient: 1

Subject objectives

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

Recommended prior knowledge
The basics of programming acquired in computer science 1 and 2

Content of the material:

PW 1: Presentation of a scientific programming environment
(Matlab, Scilab, etc.) 1 week
PW 2: Script files and Types of data and variables 2 weeks
PW 3: Reading, displaying and saving data 2 weeks
PW 4: Vectors and matrices 2 weeks
PW 5: Control instructions (for and while loops, if and switch instructions) 2 weeks
PW 6: Function files 2 weeks
PW 7: Graphics (Management of graphic windows, 2-week plot
PW 8: Using toolbox 2 weeks

Evaluation mode: Continuous monitoring: 100%.

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

1- Computer science: Programming and simulation in Scilab2014 - Authors: Arnaud Bégyn, Jean-Pierre Grenier, Hervé Gras.

2- Scilab: From theory to practice - I. The fundamentals. Book by Philippe Roux 2013.

Semester: *3*
Teaching unit: UEM 2.1
Subject 1: Technical drawing
VHS: 10h30 (PW 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge (brief description of the knowledge required to be able to follow this course – Maximum 2 lines).

In order to follow this course, basic knowledge of the general principles of drawing is required.

Content of the subject

Chapter 1: General. **2 weeks**

1.1 Usefulness of technical drawings and different types of drawings.
1.2 Drawing materials.
1.3 Standardization (Types of lines, Writing, Scale, Drawing format and folding, cartridge, etc.).

Chapter 2: Elements of descriptive geometry **6 Weeks**

2.1 Notions of descriptive geometry.
2.2 Orthogonal projections of a point - Outline of a point - Orthogonal projections of a straight line (any and particular) - Sketch of a straight line - Traces of a straight line - Projections of a plan (Any and particular positions) - Traces of a plan.
2.3 Views: Choice and arrangement of views – Rating – Slope and conicity – Determination of the 3rd view from two given views.
2.4 Method of executing a drawing (layout, 45° straight line, etc.)
Application exercises and evaluation (PW)

Chapter 3: Perspectives **2 Weeks**

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

Chapter 4: Cuts and Sections **2 Weeks**

4.1 Sections, standardized representation rules (hatching).
4.2 Projections and sections of simple solids (Projections and sections of a cylinder, a prism, pyramid, cone, sphere, etc.).
4.3 Half-cut, Partial cuts, broken cuts, Sections, etc.
4.4 Technical vocabulary (terminology of machined shapes, profiles, piping, etc.
Application exercises and evaluation (PW).

Chapter 5: **2 Week Rating**

5.1 General principles.

5.2 Rating, tolerance and adjustment.

Application exercises and evaluation (PW).

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

Application exercises and evaluation (PW).

Evaluation mode: Continuous monitoring: 100%.

Bibliographic references:

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

1. Industrial designer's guide Chevalier A. Edition Hachette Technique ;
2. Technical drawing 1st part descriptive geometry Felliachi d. and Bensaada s. Edition OPU Algiers;
3. Technical drawing part 2 industrial drawing Felliachi d. and bensaada s. Edition OPU Algiers;
4. First notions of technical drawing AndreRicordeau EditionAndreCasteilla;
5. **المدخل إلى الرسم الصناعي** ماجد عبد الحميد ديوان المطبوعات الجامعية الجزائر
6. **مبادئ أساسية في الرسم الصناعي** عمر أبو حنيك المعهد الجزائري للتقيي سالملكية الصناعية طبع الحميد ديوان المطبوعات الجامعية الجزائر

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

Semester : *3*
Teaching unit: UEM 2.1
Subject 1: PW Waves and Vibrations
VHS: 3:00 p.m. (PW1h00)
Credits: 1
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

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

Content of the material:

PW.1 Mass – spring
PW.2 Simple pendulum
PW.3 Torsion pendulum
PW.4 oscillating electric circuit in free and forced regime
PW.5 Coupled pendulums
PW.6 Transverse oscillations in vibrating strings
PW.7 Groove pulley according to Hoffmann
PW.8 Electromechanical systems (The electrodynamic loudspeaker)
PW.9 Pohl's pendulum
PW.10 Propagation of longitudinal waves in a fluid.

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

Evaluation method:

Continuous control: 100%.

Bibliographic references:

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

Semester: 3
Teaching unit: UED 2.1
Subject 1: Basic technology
VHS: 10h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

This teaching will allow students to acquire knowledge on the processes for obtaining and manufacturing parts and their assembly techniques.

Recommended prior knowledge

Content of the subject

Chapter 1: Materials **3 Weeks**

1.1. Metals and alloys and their designations
1.2 Plastic materials (polymers)
1.3 Composite materials
1.4 Other materials

Chapter 2: Processes for obtaining parts without material removal **4 Weeks**

2.1 Casting, Forging, stamping, Rolling, Wire drawing, extrusion…. Etc
2.2 Cutting, bending and stamping, etc.
2.3 Sintering and powder metallurgy
2.4 Profiles and Pipes (steel, aluminum);
- Workshop visits.

Chapter 3: Processes for obtaining parts by material removal **4 Weeks**

Turning, milling, drilling; adjustment, etc.
- Workshop visits and demonstrations.

Chapter 4: Assembly Techniques **4 Weeks**

- Bolting, riveting, welding, etc.

Evaluation method: Final exam: 100%.

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

- Manual of mechanical technology, Guillaume SABATIER, et al Ed. Dunod.
- Memotech: materials production and machining BARLIER C. Ed. Casteilla
- Industrial sciences MILLET N. ed. Casteilla
- Memotech: Industrial technologies BAUR D. et al, Ed. Casteilla
- Dimensional metrology CHEVALIER A. Ed. Delagrave
- Drilling, milling JOLYS R and LABELL R. Ed. Delagrave
- Guide to mechanical manufacturing PADELLA P. Ed. Dunod

- Technology: first part, Bensaada S and FELIACHI d. Ed. OPU Algiers
- ديوان المطبوعات الجامعية الجزائر .Remove the water from the water

Semester: 3
Teaching unit: UED 2.1
Subject 2: Metrology
VHS: 10h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

Teach the student the precision criteria for manufacturing and assembling parts; know and know how to choose, in different cases, the methods and means of controlling and measuring the dimensions and manufacturing defects of mechanical parts.

Recommended prior knowledge

Trigonometry, optical and other.

Content of the subject

Chapter 1: General information on metrology **2 Weeks**

1.1 Definition of the different types of metrology (scientific, so-called laboratory, legal, industrial);
1.2 Metrological vocabulary, definition;
1.3 National and international metrology institutions.

Chapter 2: The international SI measurement system **3 Weeks**

2.1 Basic quantities and their units of measurement;
2.2 Additional sizes;
2.3 Derived quantities.

Chapter 3: Metrological characteristics of measuring devices **6 Weeks**

3.1 Error and uncertainty (Accuracy, precision, fidelity, repeatability, reproducibility of a measuring device
3.2 Classification of measurement errors
3.2.1 Gross value;
3.2.2 Systematic error;
3.2.3 Corrected gross value.
3.3 Accidental errors
3.3.1 Random errors;
3.3.2 Spurious errors;
3.3.3 Estimated systematic errors.
3.4 Confidence interval;
3.5 Technical uncertainty;
3.6 Total measurement uncertainty;
3.7 Complete measurement result;
3.8 Identification and interpretation of specifications of a definition drawing for the purpose of control;
3.9 Basic concepts of calibers, gauges and simple measuring instruments.

Chapter 4: Measurement and control **4 Weeks**

4.1 Direct measurement of lengths and angles (use of ruler, caliper, micrometer and protractor);
4.2 Indirect measurement (use of comparator, gauge blocks);
4.3 Dimensions control (use of buffers, jaws, etc.);
4.4 Measuring and control machines used in mechanical workshops (use of pneumatic comparator, profile projector and roughness meter.

Evaluation method: Final exam: 100%.

Bibliographic references:

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

- Manual of mechanical technology, Guillaume SABATIER, et al Ed. Dunod.
- Memotech: materials production and machining BARLIER C. Ed. Casteilla
- Industrial sciences MILLET N. ed. Casteilla
- Memotech: Industrial technologies BAUR D. et al, Ed. Casteilla
- Dimensional metrology CHEVALIER A. Ed. Delagrave
- Drilling, milling JOLYS R and LABELL R. Ed. Delagrave
- Guide to mechanical manufacturing PADELLA P. Ed. Dunod
- Technology: first part, Bensaada S and FELIACHI d. Ed. OPU Algiers
- ديوان المطبوعات الجامعية الجزائر .Remove the water from the water

Semester: *3*
Teaching unit: UED 2.1
Subject 1: Technical English
VHS: 10h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

This course must allow the student to have a language level where he will be able to use a scientific document and talk about his specialty and sector in English at least with ease and clarity.

Recommended prior knowledge

English 1 and English 2

Content of the subject

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

Evaluation method: Final exam: 100%.

Bibliographic references:

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

Semester: 4
Teaching Unit: UEF 2.2.1
Subject: Physical chemistry
VHS: 45h00 (Course: 1h30, Tutorial: 1h30)
Credit: 4
Coefficient:2

Teaching objectives :
UNDERSTAND THE FUNDAMENTAL PRINCIPLES OF THERMODYNAMICS AND KNOW HOW THEY APPLY TO SPR O _ VARIED THERMODYNAMIC Blemishes _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Recommended prior knowledge:
General chemistry, mathematics (differentials, integrals)

Content of the material:
I - Basic principles and concepts of thermodynamics. (8 weeks)

1 Definition and terminology of terms used in thermodynamics.

2- Concept of heat, work and energy.

3- Discussion of the first and second principles of thermodynamics, their development, formulation and application.

4- Concept of entropy and free energy, important consequences of these laws and their application,

5- Standard free energy and effect of temperature and pressure,

6- Third law of thermodynamics.

7 - Thermodynamic analysis of processes and equilibrium state, equilibrium constant,

8- Laws of equilibrium displacement: Influence of temperature and pressure, influence of an inert gas.

9- Ellingham diagram of metal oxides.

10 - Phase Equilibrium, concept of the chemical potential of a gas.

11- Multi-phase equilibrium conditions.

12 - Gibbs phase rule: concept of a phase, a constituent and the variance of a system.

13 - Application of the Gibbs phase rule to heterogeneous systems and chemical reactions.

14- Clapeyron equation: relationship between P and T during a phase transition.

15- Balance diagrams: unary, binary and ternary.

16- Thermodynamics of Solutions,

16.1 Partial molar quantities,

16.2 Integral quantities,

16.3 Gibbs Duhem equations.

16.4 Ideal solution, Raoult's law, their deviation, concept of activity, diluted solutions,

Henry's law. Real solutions.

II - Chemical kinetics (7 weeks)

1- reaction speed,
2- Influence of concentrations.
3- Order of reactions: partial order, global order, experimental determination of the reaction order
4- Determination of order by integration.
5- Influence of temperature (ARRHENIUS relationship).
6- Activated complex theory
7- Heterogeneous reactions and importance of the steps that control the process.
8- Homogeneous and heterogeneous catalysis

Evaluation method:

Continuous monitoring: 40%; Exam: 60%.

Reference:

- Elements of physical chemistry. Peter Williams Atkins. 1998. DeBoeck University.
- Physical chemistry course. Paul Arnaud. 6th edition Dunod. 2007

Semester: 4
Teaching Unit: UEF 2.2.1
Subject: Mineralogy and crystallography
VHS: 10h30 , (Course: 1h30)
Credit: 2
Coefficient: 1

Teaching objectives:

The aim of this course is to learn basic knowledge about minerals: explain their shape, their internal atomic structure, their chemical composition; learn to recognize minerals macroscopically, and under a polarizing microscope.

Recommended prior knowledge:

For this course, knowledge is required in mathematics, trigonometry, general physics, and optics, general and mineral chemistry

Content of the material:

Chapter I: Crystal structure (4 weeks) The direct network

1- translation vectors
2- The elementary and multiple mesh
3- Stacking
4- The hard sphere model
5- Bravez's networks
6- Study of some simple structures: example of NaCl, CsCl, CaF2, graphite, diamond
7- Clues to plans and directions
8- Area law enforcement
9- The reciprocal network: Definition
10- Vectors and reciprocal volume
11- The cubic system; the hexagonal system.

Chapter II: Symmetry (4 weeks)

1- Symmetry in networks
2- Crystallographic projections: spherical and stereographic

Chapter III: Crystallogenesis and study of some useful minerals (4 weeks)

1-Example study of silicate
2-Example of carbonate

Chapter IV: X-ray crystallography (3 weeks)

1- X-rays and their application to the study of structures

Production; Absorption and diffraction of x-rays by matter

Evaluation method:

Review: 100%.

Reference:

- Elements of Mineralogy and Crystallography Picon, M.; Flahaut, J. 1957
- Courses in Mineralogy and Crystallography. G.Cezaro.2010
- Crystallography and X-ray crystallography. JJ Rousseau. 2007

Semester: 4
Teaching Unit: UEF 2.2.2
Subject: Mathematics 4
VHS: 45h00 (Course: 1h30, Tutorial: 1h30)
Credit: 4
Coefficient: 2

Teaching objectives:

This course covers the differential and integral calculus of complex functions of a complex variable. The student must master the different techniques for solving functions and integrals with complex and special variables.

Recommended prior knowledge:

Mathematics 1, Mathematics 2 and Mathematics 3.

Content of the material:

Functions with complex variables and Special Functions

Chapter 1: Holomorphic functions. Cauchy Riemann conditions 3 weeks

Chapter 2: Entire series 3 weeks
Convergence radius. Convergence domain. Development in whole series. Analytical Functions. Laurent series and development in Laurent series

Chapter 3: Cauchy theory 3 weeks
Cauchy's theorem; Cauchy formulas. Singular point of functions, general method for calculating complex integrals

Chapter 4: Applications 4 weeks
Equivalence between holomorphy and Analyticity. Maximum Theorem. Liouville's theorem. Rouche's theorem. Residue Theorem. Calculation of integrals using the Residue method.

Chapter 5: Special Functions 2 weeks
Special Euler functions: Gamma, Beta functions, applications to integral calculations

Evaluation method:

Continuous monitoring: 40%; Exam: 60%.

Bibliographic references:

1 - Henri Catan, Elementary theory of analytical functions of one or more complex variables. Publisher Hermann, Paris 1985.
2- Jean Kuntzmann, Complex variable. Hermann, Paris, 1967. Undergraduate textbook.
3- Herbert Robbins Richard Courant. What is Mathematics?, Oxford University Press, Toronto, 1978. Classic popular work.
4- Walter Rudin, Real and complex analysis. Masson, Paris, 1975. Graduate manual.

Semester: 4
Teaching Unit: UEF 2.2.2
Subject: Numerical methods
VHS: 45h00, (Course: 1h30, Tutorial: 1h30)
Credit: 4
Coefficient: 2

Teaching objectives: Familiarization with numerical methods and their applications in the field of mathematical calculations.
Recommended prior knowledge: Math1, Math2, Computer Science1 and Computer Science 2
Content of the material:

Chapter 1: Solving nonlinear equations f(x)=0 (3 weeks)

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

Chapter 2: Polynomial interpolation (2 weeks)

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

Chapter 3 Function Approximation:(2 weeks)

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

Chapter 4: Digital integration (2 weeks)

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

Chapter 5: Resolution of ordinary differential equations (2 weeks) (initial condition or Cauchy problem).

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

Chapter 6: Direct solution method for systems of linear equations (2 weeks)

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

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

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

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

References:

1. BREZINSKI (C.), Introduction to the practice of numerical calculation. Dunod, Paris (1988).
2. G. Allaire and SM Kaber, 2002. Numerical linear algebra. Ellipses.
3. G. Allaire and SM Kaber, 2002. Introduction to Scilab. Corrected practical exercises in linear algebra. Ellipses.
4. G. Christol, A. Cot and C.-M. Marle, 1996. Differential calculus. Ellipses.
5. M. Crouzeix and A.-L. Mignot, 1983. Numerical analysis of differential equations. Masson.
6. S. Delabrière and M. Postel, 2004. Approximation methods. Differential equations. Scilab applications. Ellipses.
7. J.-P. Demailly, 1996. Numerical analysis and differential equations. Presses Universitaires de Grenoble, 1996.
8. E. Hairer, SP Norsett and G. Wanner, 1993. Solving Ordinary Differential Equations, Springer.
9. CIARLET (PG). Introduction to matrix numerical analysis and optimization. Masson, Paris (1982).

, Paris (1982).

Semester: 4
Teaching Unit: UEF 2.2.3
Material: Resistance of materials
VHS: 45h00, (Course: 1h30, Tutorial: 1h30)
Credit: 4
Coefficient: 2

Teaching objectives: Know the methods of calculating the resistance of construction elements and determine the variations in the shape and dimensions (deformations) of the elements under the action of loads.

Recommended prior knowledge: Function analysis; rational mechanics.
Content of the material:

Chapter 1 : INTRODUCTIONS AND GENERAL **(2 weeks)**
- 1.1 Goals and Assumptions of Material Strength
- 1.2 Classification of solids (beam, plate, shell)
- 1.3 Different types of loading
- 1.4 Connections (supports, fittings, ball joints)
- 1.5 General principle of equilibrium – Balance equations
- 1.6 Principles of cutting – Elements of reduction
- 1.7 Definitions and sign conventions of:
  - Normal force N,
  - Shear force T,
  - Bending moment M

Chapter 2 : TRACTION AND COMPRESSION **(3 weeks)**
- 2.1 Definitions
- 2.2 Normal tensile and compressive stress
- 2.3 Elastic deformation in traction/compression
- 2.4 Tensile/compressive strength condition

Chapter 3 : SHEAR **(2 weeks)**
- 3.1 Definitions
- 3.2 Simple shear – pure shear
- 3.3 Shear stress
- 3.4 Elastic deformation in shear
- 3.5 Shear resistance condition

Chapter 4 : GEOMETRIC CHARACTERISTICS OF STRAIGHT SECTIONS **(3 weeks)**
- 4.1 Static moments of a straight section
- 4.2 Moments of inertia of a straight section
- 4.3 Formulas for transforming moments of inertia

Chapter 5 : TORSION **(2 weeks)**
- 5.1 Definitions

5.2 Tangential or sliding stress
5.3 Elastic torsional deformation
5.4 Torsion resistance condition

Chapter 6 : SIMPLE PLANE FLEXION **(3 weeks)**

6.1 Definitions and assumptions
6.2 Cutting force, bending moments
6.3 Diagram of shear forces and bending moments
6.4 Relationship between bending moment and shear force
6.5 Deformation of a beam subjected to simple bending (arrow)
6.6 Calculation of constraints and sizing

Evaluation method:

Continuous monitoring: 40%; Exam: 60%.

Reference:

- Mechanics for engineers – statics. Ferdinand P. Beer and Russell Johnston, Jr., McGraw-Hill, 1981.
- Resistance of materials, P. STEPINE, Editions MIR; Moscow, 1986.
- Strength of Materials 1, William A. Nash, McGraw-Hill, 1974.
- Resistance of materials, S. Timoshenko, Dunod, 1986

Semester: 4
Teaching Unit: UEM 2.2
Subject: Computer-assisted drawing
VHS: 10h30 (PW: 1h30)
Credit: 2
Coefficient: 1

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

Recommended prior knowledge: Technical Drawing. .

Content of the material:

1. PRESENTATION OF THE CHOSEN SOFTWARE **(4 weeks)**
(SolidWorks, Autocad, Catia, Inventor, etc.)
1.1 Introduction and history of the DAO;
1.2 Configuration of the chosen software (interface, shortcut bar, options, etc.);
1.3 Software reference elements (software help, tutorials, etc.);
1.4 Backup of files (part file, assembly file, drawing file, backup procedure for delivery to the teacher);
1.5 Communication and interdependence between files.

2. CONCEPT OF SKETCHES **(3 weeks)**
2.1 Sketching tools (point, line segment, arc, circle, ellipse, polygon, etc.);
2.2 Sketch relationships (horizontal, vertical, equal, parallel, hillside, fixed, etc.);
2.3 Dimensions of sketches and geometric constraints.

3. 3D MODELING **(3 weeks)**
3.1 Concepts of planes (front plane, right plane and top plane);
3.2 Basic functions (extrusion, material removal, revolution):
3.4 Display functions (zoom, multiple views, multiple windows etc.):
3.5 Modification tools (Delete, Shift, Copy, Mirror, Adjust, Extend, Move):
3.6 Creating a sectional view of the model.

4. DESIGN OF THE 3D MODEL **(3 weeks)**
4.1 Editing the plan and the title block:
4.2 Choice of views and drawing:
4.3 Object layouts and properties (hatching, dimensioning, text, tables, etc.)

5. ASSEMBLY **(2 weeks)**
5.1 Assembly constraints (parallel, coincidence, coaxial, fixed, etc.):
5.2 Production of assembly drawings:
5.3 Assembly drawing and part nomenclature:
1. Exploded view.

Evaluation method:
Continuous control: 100%.

References:

- Solidworks bible 2013 Matt Lombard, Edition Wiley,
- Technical drawing, Saint-Laurent, GIESECKE, Frederick E. Éditions du renouveau pedagogical Inc., 1982.
- Drawing exercises for mechanical parts and assemblies with SolidWorks software, Jean-Louis Berthéol , François Mendes ,
- CAD accessible to all with SolidWorks: from creation to production volume 1 Pascal Rétif ,
- Industrial designer's guide, Chevalier A, Edition Hachette Technique,

Semester: 4
Teaching Unit: UEM 2.2
Subject: PW Physical Chemistry
VHS: 10h30 (PW: 1h30)
Credit: 2
Coefficient: 1

Teaching objectives:
As the manipulations progress, students will be able to determine different quantities, coefficients detailed in the physical chemistry course as well as the speed of the reactions.

Recommended prior knowledge:
Physical chemistry, general chemistry, mathematics (differentials, integrals)
Content of the material:

Notions on ideal and non-ideal solutions:

Practical work no. 1: Determination of liquid-vapor equilibrium

PW No. 2: Determination of the partition coefficient

Practical work no. 3: Determination of the acidity constant

Chemical thermodynamics:

PW n°4: Calorimetry,

PW No. 5: Determination of thermodynamic quantities by spectrometry

PW No. 6: Determination of chemical potential: the battery

Chemical kinetics:
PW No. 7: 1st order kinetics by spectrometry,
PW No. 8: 2nd order kinetics by conductimetry

Evaluation method:
Continuous control: 100%.

Semester: 4
Teaching Unit: UEM 2.2
Subject: PW numerical methods
VHS: 10h30 , (PW: 1h30)
Credit: 2
Coefficient: 1

Teaching objectives: Programming of different numerical methods with a view to their applications in the field of mathematical calculations using a scientific programming language (matlab, scilab, etc.).

Recommended prior knowledge:
Numerical method, Computer science 2 and computer science 3.

Content of the material:

1. Solving nonlinear equations **(3 weeks)**
   - 1.1. Bisection method
   - 1.2. Fixed point method
   - 1.3. Newton–Raphson method
   - 1.4.
2. Interpolation and approximation **(3 weeks)**
   - 2.1. Newton interpolation
   - 2.2. Chebyshev approximation
3. Digital integrations **(3 weeks)**
   - 3.1. Rectangle Method
   - 3.2. Trapeze method
   - 3.3. Simpson method
4. Differential equations **(2 weeks)**
   - 4.1. Euler's method
   - 4.2. Runge-Kutta methods
5. Systems of linear equations **(4 weeks)**
   - 5.1. Gauss-Jordon method
   - 5.2. Crout decomposition and LU factorization
   - 5.3. Jacobi method
   - 5.4. Gauss-Seidel method

Evaluation method:
Continuous control: 100%.

References:

1. Algorithmics and numerical calculation: solved practical work and programming with Scilab and Python software / José Ouin , . - Paris: Ellipses , 2013. - 189 p.
2. Mathematics with Scilab: calculation guide, programming graphic representations; compliant with the new MPSI / Bouchaib Radi program ; Abdelkhalak El Hami . - Paris: Ellipses , 2015. - 180 p.

3. Applied numerical methods: for the scientist and the engineer / Jean-Philippe Grivet , . - Paris: EDP sciences , 2009. - 371 p.

Semester: 4
Teaching Unit: UEM 2.2
Material: PW Material resistance
VHS:15 (PW: 1h00)
Credit: 2
Coefficient: 1

Teaching objectives:
Apply the different stresses studied in the materials resistance module and determination of material characteristics based on simple mechanical tests.

Recommended prior knowledge: Resistance of materials, materials sciences.

Content of the material:

PW No. 1: Tensile – simple compression tests
PW No. 2: Torsion test
PW No. 3: Simple bending test
PW No. 4: Resilience test
PW No. 5: Hardness test

Evaluation method:
Continuous control: 100%.

Semester: 4
Teaching Unit: UEM 2.2
Subject: PW Mineralogy and crystallography
VHS: 10h30 , (PW: 1h30)
Credit: 2
Coefficient: 1

Teaching objectives:
The aim of this educational unit is to implement the basic knowledge acquired on minerals: learning to recognize minerals, to develop certain crystals and to learn to interpret diffractograms.

Recommended prior knowledge:
Crystallography and X-ray crystallography; mineralogy, general and general mineral chemistry, optics, general and mineral chemistry

Content of the material:

PW n°1: Determination of symmetry elements
PW n°2: Calculation of Miller hkl indices (Calculation of parameters linked to the mesh: coordination; density, compactness for some structures: Fluorite, halite, quartz, diamond, graphite, etc.)
Practical work no. 3: Stereographic projection of symmetry elements
Practical work n°4: Preparation of simple crystals: NaCl and CuSO4 (at home)
PW n°5: Analysis of diffractogram (X-rays)

Evaluation method:
Continuous control: 100%.

Semester: 4
Teaching Unit: UED 2.2
Material: Material Properties
VHS: 10h30, (Course: 1h30)
Credit: 1
Coefficient: 1

Teaching Objectives:
By the end of this course, students will be able to describe the classical mechanical behaviors of different material types (metals and alloys, ceramics, glasses). They will analyze mechanical behaviors revealed through material use or mechanical testing. Additionally, this course will help them link mechanical properties to the (micro) structure and identify key parameters that can influence these properties.

Recommended Prerequisite Knowledge:
Physics, structural chemistry

Subject Content:

I- Mechanical Properties **(5 weeks)**
I.1- Hardness properties: HRA, HRB, HRC, HV
1.2- Tensile properties
1.2.1 Yield strength
1.2.2 Ultimate tensile strength
1.2.3 Elongation
1.2.4 Reduction in area
1.2.5 Young's modulus
1.2.6 Work hardening and anisotropy coefficient
2- Resilience (ductility determined by various fracture modes like Charpy, ISOD)
3- Fatigue and creep testing
4- Tribological properties
4.1- Wear resistance
4.2- Roughness
4.3- Adhesion

II- Physical Properties **(5 weeks)**
1- Thermal properties
2- Magnetic properties (measurement of coercive field)
3- Optical properties
4- Electrical properties (resistivity and conductivity)
5- Chemical properties (corrosion)
6- Microstructural properties (grain size considering quantitative microscopy)
7- Technological properties (bending, flaring, internal pressure, forgeability, fluidity, and castability)

III- Considered Materials **(5 weeks)**
a. Metallic materials (Steels, Cast irons, Non-ferrous alloys)
b. Ceramics
c. Biomaterials
d. Glasses and ceramics

e. Nanomaterials

Assessment Method:

Exam: 100%

References:

Science et génie des matériaux/Auteurs:CallisterWD/ Ed : Dunod
Des matériaux/Auteurs: BaïlonJP et DorlotJM/ Ed: Montréal, Presse internationale polytechnique

Semester: 4
Teaching Unit: UED 2.2
Subject: Extractive metallurgy
VHS: 10h30 , (Course: 1h30)
Credit: 1
Coefficient: 1

Teaching objectives:

Allow students to become acquainted with different metals as well as the methods of extraction and production of these

Recommended prior knowledge:

General and mineral chemistry

Content of the material:

Chapter I : Industrial processes for producing metals and alloys **(5 weeks)**

1- Steel making
2- Production of aluminum
3- Production of nickel
4- Copper production
5- Production of zinc
6- Elaboration of titanium and zirconium

Chapter II : Unit operations **(5 weeks)**

1- "Solid/solid" and "solid/fluid" separation operations
2- Fluid phase separation operations
3- Chemical unit operations and reactors in pyrometallurgy
4- Chemical unit operations and reactors in hydrometallurgy

Chapter III : Thermodynamics of pyrometallurgical transformations: transformations of solid particles **(5 weeks)**

1- Thermodynamic data on oxide formation reactions
2- Reduction of oxides
3- Roasting of sulfides
4- Oxide chlorination

Evaluation method :

Review: 100%.

Reference:

- Extractive metallurgy. Volumes 1,2,3. Alain Vignes.Hermes publication
- From ore to material. A.Vignes. Hermes. 2013.

Semester :4
Teaching unit: UET2.2
Subject: Expression, information and communication techniques
VHS: 10h30 (Course: 1h30)
Credits:1
Coefficient:1

Teaching objectives:

This teaching aims to develop the student's skills, on a personal or professional level, in the field of communication and expression techniques. It also allows the student to know the techniques, tools and methods used to facilitate communications.

Recommended prior knowledge:

Languages (Arabic; French; English)

Material content:

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

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

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

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

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

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

Chapter 7: Securing sensitive information, Protection of confidential data and Preservation of nuisances. (3 weeks)
Backup of important data, “Informatics and freedoms” law, Internet dangers, Computer hacking, Machine protection, Protection against viruses, Protection against cyber threats or online threats

(Phishing, spam emails, spyware, malware, ransomware, viruses and trojan horses, man-in-the-middle attacks, etc.), Preventing data loss, Spam, Hoaxes, Cryptology, Electronic signature….

Evaluation method:

Final exam: 100%.

Bibliographic references:

(Books *and handouts, websites, etc.)*

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

Semester:5
Teaching unit: FTU 3.1.1
Subject Matter : Physical metallurgy1
HV: 67h30 (Courses: 3h00, SW: 1h30)
Credits: 6
Coefficient : 3

Teaching objectives:

Understand the peculiarity of metallic bonding in metals. The crystalline structures of metals and their imperfections. Mechanisms of elastic and plastic deformation and hardening, as well as restoration and recrystallization, on an atomic scale. The final part of the course covers binary and tertiary equilibrium diagrams.

Recommended prior knowledge:

Chemistry-physics S4, Mineralogy and crystallography S4.

Contents :

Chapter 1.Crystal structure (01 week)

Bonding and interaction forces.

Crystal lattice and notions of crystallographic planes and directions, compactness.

Chapter 2: Crystal lattice imperfections (02 week)

Point defects, linear defects, surface defects.

Interactions between dislocations, dislocation-gap interactions, type of solid solutions.

Chapter 3: Plastic deformation and fracture (03 weeks)

Elastic deformation, plastic deformation, work hardening, fractures of metals (ductile, brittle and mixed).

Chapter 4 Different hardening mechanisms (03 weeks)

Hardening by work hardening, by solid solution, by precipitates, by substructure, by grain size, by second phase.

Chapter 5 Restoration and recrystallization (01 week)

Restoration. Recrystallization.

Chapter 6 Solidification (03 weeks)

Solidification of a pure metal: thermodynamic aspects

Phase rules at constant pressure.

Homogeneous and heterogeneous germination, growth with supercooling.

Equiaxed dendritic structure. Columnar dendritic structure.

Chapter 7. Ternary and binary equilibrium diagrams with transformations (02 weeks)

Eutectic, eutectoid, polymorphic, peritectic, congruent, non-congruent etc .....

Assessment:

Continuous assessment 40%; Examination 60%.

Bibliographic references:

1. Chalmers, General Metallurgy
2. Bénard, Elements of Physical Metallurgy
3. Lakhtine, Physical metallurgy
4. Devendra Gupta, Diffusion processes in advanced Technological Materials
5. JRDavis, Surface Engineering for corrosion and wear resistance
6. G.Totten, Handbook of residual stress and deformation of steel
7. Jean-Jacques Rousseau, Alain Gibaud, Geometric crystallography and radiocrystallography, Courses and corrected exercises, (2007)

Semester: 5
Teaching unit: UEF 3.1.1
Matter: Heat and mass transfer
VHS: 45h (lesson: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:

This material has two parts, the first; allows the student to learn and assimilate the different modes of heat transfer and the laws that govern them, the second part treats and explains the diffusion phenomenon and gives the laws that govern it.

Recommended prior knowledge:

Mathematics

Content of the material:

PART A: Heat Transfer

Chapter 1. **General information on heat transfers.** ***(01 week)***

Introduction. Definitions; heat, temperature fields, temperature gradient, flow.

Chapter 2. Heat transfers by conduction in steady state ***(01 week)***

The Heat equation. Unidirectional heat transfer. Multi-directional heat transfer.

Chapter 3. **Heat transfers by conduction in variable regime** ***(02 weeks)***

Unidirectional conduction in variable regime. Multidirectional conduction in variable regime.

Chapter 4. **Heat transfers by convection** ***(02 weeks)***

Reminders on dimensional analysis. Convection without change of state. Convection with change of state

Chapter 5 **Heat transfers by radiation** ***(01 week)***

Laws of radiation. Reciprocal radiation of several surfaces

PART B: Mass transfer

Chapter 1 : Diffusion phenomena in the solid state ***(01 week)***

Chapter 2 : Fick's Laws ***(02 weeks)***

Fick's 1st law

Fick's 2nd law, Diffusion coefficient

Chapter 3 : Phenomenological theory of diffusion ***(01 week)***

Chapter 4: Diffusion in metals and alloys in the absence of chemical gradients ***(01 week)***

Chapter 5 : Surface diffusion ***(01 week)***

Chapter 6 : Application of diffusion ***(02 week)***

Homogenization, carburizing, welding and brazing, metal oxidation, sintering.

Assessment method: Continuous assessment 40%; Exam 60%

Bibliographic references:

1. Donald Pitts, Theory and problems of heat transfer, second edition, Schaum's, McGraw-Hill, 1998.
2. Jean-Luc Battaglia, Andrzej Kusiak, Jean-Rodolphe Puiggali, Introduction to thermal transfers: Courses and corrected exercises, Dunod, 2014.
3. Michael J. Moran, Introduction to thermal Systems Engineering: Thermodynamics, Fluid Mechanics, and Heat Transfer, John Willey & Sons Inc. 2003.
4. Devendra Gupta, Diffusion processes in advanced Technological Materials

Semester: 5
Teaching unit: UEF 3.1.2
Subject: Elaboration of ferrous metals
VHS: 45h (lesson: 3h00)
Credits: 4
Coefficient: 2

Teaching objectives:

Arm the student with basic knowledge and methods for obtaining cast iron, steel and other metals. This knowledge comes before any treatment or modification on a metal.

Recommended prior knowledge:

Basic technology S3, Physical chemistry S4, Extractive metallurgy S4.

Content of the material:

Part 1. Elaboration of cast iron

Chapter 1 Theoretical study of Blast furnace ***(01 week)***

Chapter 2 Study of oxidation-reduction ***(02 weeks)***

Chapter 3 Laitiers : constitution and properties ***(01 week)***

Chapter 4 Formation of cast iron: composition, classification and properties ***(02 weeks)***

Part 2. Elaboration of steel

Chapter 5 : Evolution and current state of refining reactors . ***(01 week)***

Chapter 6 Theoretical aspects of refining ***(01 week)***

Chapter 7 Steel elaboration in the converter ***(02 weeks)***

Chapter 8 General information on electric furnace. ***(01 week)***

Chapter 9 Particularities of steel production in arc furnaces ***(01 week)***

Chapter 10 Technology and physico-chemistry ***(01 week)***

Chapter 11 Elaboration of special steels ***(02 weeks)***

Evaluation method: ; Review: 100%.

Bibliographic references:

1. Extractive metallurgy. Volumes 1,2,3. Alain Vignes. Hermes publication
2. From ore to material. A.Vignes. Hermes. 2013.
3. MF Ashby, DRH Jones, *Materials 2, Microstructure and implementation,* Dunod, Paris.

Semester: 5
Teaching unit: UEF 3.1.2
Subject: Mechanical behavior of metals and alloys
VHS: 45h (lesson: 1h30, tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching Objectives:

This subject, following the material properties taught in S4, explores the various types of mechanical behavior exhibited by metals and alloys. It presents the governing laws behind these behaviors and explains modes of damage and failure in metals.

Recommended Prerequisite Knowledge:

Material properties S4.

Subject Content:

Chapter 1: Elasticity **(2 weeks)**

Elastic constants. Generalized Hooke's law.

Chapter 2: Plasticity **(3 weeks)**

Yield strength. Plastic deformation threshold. Plasticity criteria. Plastic behavior laws: perfect elasticity-plasticity, elasticity-plasticity with linear hardening, elasticity-plasticity with power hardening, etc.

Chapter 3: Rheological Behavior **(2 weeks)**

3.1 Viscoelastic behavior.

3.2 Viscoplastic behavior.

Chapter 4: Introduction to Fracture Mechanics **(2 weeks)**

Brittle behavior, toughness, stress intensity factor.

Chapter 5: Fracture **(3 weeks)**

5.1 Various modes of failure and damage.

5.2 Fatigue crack propagation and stress corrosion cracking.

Chapter 6: High-Temperature Mechanical Behavior **(3 weeks)**

Thermomechanical rolling, creep, etc.

Assessment Method:

Continuous assessment: 40%; Exam: 60%.

Bibliographical References:

Science et génie des matériaux. Callister W.D.: Ed: Dunod.

Des matériaux. Baïlon J.P. et Dorlot J.M. Ed : École polytechnique Montréal.

Semester: 5
Teaching unit: UEM 3.1
Material: PW Heat and mass transfer
VHS: 10:30 p.m. (PW: 1:30 a.m.)
Credits: 2
Coefficient: 1

Teaching objectives:

This teaching allows students to put into practice and verify the knowledge acquired in the subject of heat and mass transfer.

Recommended prior knowledge:

S3 fluid mechanics, heat and mass transfer.

Content of the material:

(Depending on the resources available in the establishment)

PW Linear conduction.

PW Radial conduction.

PW Free and forced convection.

PW Radiation.

Practical simulation using software on the different types of transfer.

PW Study of solid-solid diffusion (body cementation); observation of metal before and after carburizing and measurement of hardness.

PW Metal powder sintering.

Evaluation mode: Continuous monitoring: 100%.

Bibliographic references:

Handling manuals.

Semester: 5
Teaching unit: UEM 3.1
Subject: PW Metallurgy Physics 1
VHS: 45h00 (PW: 3h00)
Credits: 4
Coefficient: 2

Teaching objectives:

This teaching allows students to put into practice and verify knowledge acquired in the subject physical metallurgy 1. This subject represents for the student the opportunity to learn the techniques of preparing different samples for observations with an optical microscope. These observations concern the different structures of different materials as well as their defects. It is also a question of highlighting the phenomena of recrystallization and restoration in metals.

Recommended prior knowledge:

Physical metallurgy 1.

Content of the material:

1- Practical metallography work ***(04 weeks)***
   - Sample preparation techniques for different metals
   - Observation of the structures of different metals under an optical microscope
2- Observation and study of structural defects in metals and alloys ***(02 weeks)***
   - Twins, grain boundaries, pores, sinkholes
3- Study of deformation on structure and mechanical properties (case of hardness and tensile test) ***(03 weeks)***
4- Study of the phenomena of metal recrystallization and restoration

(02 weeks)

5- Simple thermal analysis and by ATD (cooling curve and critical transformation points)

(02 weeks)

Evaluation mode: Continuous monitoring: 100%.

Bibliographic references:

Semester: 5
Teaching unit: UEM 3.1
Subject: Analysis and characterization methods
VHS: 37h30 (Course: 1h30, practical work: 1h00)
Credits: 3
Coefficient: 2

Objective of teaching

Know the principle of the different characterization techniques used in determining the different properties of materials. The student must be able to define, depending on the desired characteristic or behavior to be analyzed, the technique to be implemented and the means to use to obtain it.

Recommended prior knowledge

Mineralogy and crystallography properties of materials DTA, DSC, TGA,

Content of the subject

Teaching objectives:

Know the principle of the different characterization techniques used in determining different properties of materials. The student must be able to define, depending on the characteristic sought or the behavior to be analyzed, the technique to be implemented and the means to use to obtain it.

Recommended prior knowledge:

Mineralogy and crystallography S4, Properties of materials S4.

Material content:

Chapter 1. Principles of thermal analysis (4 Weeks)

The different analysis methods; DTA: Differential Thermal Analysis; DSC: Differential enthalpy analysis; TGA: Thermo gravimetric analysis; Properties measured; Physical properties (glass transition, melting, phase change, etc.); Thermodynamic properties (specific heat, enthalpy, etc.); Equipment, principle and sensors used.

Chapter 2. Methods of analysis and observation of materials (4 Weeks)

Optical micrography; Polishing of samples. Etching of the samples; Micrographic examination of samples; Direct light microscopy. Reflected light microscopy; Metallographic microscope. Confocal microscopy: Phase contrast microscopy; Fluorescence microcopy; Atomic Forces Microscopy; Scanning electron microscopy (SEM and TEM); Equipment, principle and sensors used.

Chapter 3. Spectroscopic methods (3 Weeks)

Analysis by Ultra Violet; Interpretation of infrared spectra; X-ray diffraction: Structural determination by Patterson methods and direct methods; EDS, WDS spectroscopic analysis; Equipment, principle and sensors used.

Chapter 4. Mechanical testing and analysis methods (4 Weeks)

Conventional mechanical tests: Static tests; Tensile . Compression; Flexion; Folding; Hardness; Twist; Dynamic tests; Fatigue; DMA; Energy testing; Resilience; Tenacity; Shock tests; Rheological tests; Rheometers; Creep; Relaxation; Recovery; Tribology tests; Equipment, principle and sensors used.

Evaluation method:

Continuous monitoring: 40%; Exam: 60%.

References

1. R. Ouahas, "Radiocristallographie"
2. W.D. Callister, "Science et génie des matériaux",
3. Suzanne Degallaix et Bernhard Ischner, "Caractérisation expérimentale des matériaux", Traité des matériaux - Volume 20.
4. MARTIN Jean-Luc, GEORGE Armand, "Traité des matériaux Vol 3 : caractérisation expérimentale des matériaux, analyse par rayons X, électrons et neutrons",
5. Baïlon J.P. et Dorlot J.M "Des matériaux", Ed : École polytechnique Montréal.

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Semester: 5
Teaching unit: UED 3.1
Material: Non-metallic materials
VHS: 10:30 p.m. (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Introduce students to the science of non-metallic materials by allowing them to acquire knowledge specific to these materials. We will be particularly interested in polymer materials, ceramics and composite materials.

Recommended prior knowledge:

Knowledge of basic sciences acquired in common core

Content of the material:

Chapter 1 : **General information on plastic materials (02 weeks)**
Structures and properties, Implementation, Standardization.

Chapter 2 : **Presentation of polymer materials (03 weeks)**

- Nature and structure of polymer materials
- The macromolecular chain, Thermoplastic and thermosetting polymers
- Elastomers, amorphous polymers and semi-crystalline polymers,
- Properties of polymer materials, Mechanical properties, Physical properties, Thermomechanical tests, Long-term behavior (aging), Combustion.
- Shaping of polymers.
    - Addition or condensation polymerization

Chapter 3 : **Glass and Ceramics (03 weeks)**

- Structures of mineral glasses.
- Types of ceramics and areas of use.
- Manufacturing and microstructure of ceramics.
- Manufacturing and shaping of glasses.
- Mechanical, electrical, thermal and optical properties.
- Degradation of ceramics.

Chapter 4 : **Composite materials (04 weeks)**

- Association of materials and anisotropy.
- Constituents, properties of constituents.
- Development, shaping and properties of the different families of composites: polymer matrix, metal matrix, ceramic matrix, foams.
- Assembly and machining problem.
- Mechanical tests.
- Specificities of the mechanical behavior of composite materials.
- Calculation: homogenization, law of mixtures, law of behavior, rupture criterion.

Evaluation mode: Exam: 100%.

Bibliographic references:

1. Wilfried Kurz, Jean P. Mercier. *Introduction to materials science2nd edition* .. 1991
2. Marc Carrega and Coll *Polymer materials* . Dunod, 2000
3. Treatises on materials 14. *Polymeric materials: mechanical and physical properties.* Polytechnic and university presses Romandes. 2001
4. Claude Bathias et Coll . *Composite materials 2nd edition* . The new Dunod factory, 2009

Semester: 5
Teaching unit: UED 3.1
Subject: Standardization in Metallurgy
VHS: 10:30 p.m. (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
Learn about standardization and its importance. Know the role of patents as well as the concept of industrial property.
Recommended prior knowledge:

Content of the material:

Definition of the role and importance of standards and standardization.

The different standardization methods.

The main standards (AFNOR, DIN, ISO, ASTM).

Standards correspondence.

Patents and the patenting procedure.

Industrial property

Evaluation method: Examination: 100%.

Bibliographic references:

- ISO/IEC Directives – part 2: Rules for the structure and drafting of International Standards, fifth edition, 2004
- Certification mechanisms and methods: ISO 9001 standard certification accreditation, Pierre Frybourg 2012

Semester: 5
Teaching unit: UED 3.1
Subject: Industrial electricity
VHS: 10:30 p.m. (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives: The objective of the program is to provide Mechanical Engineering students with a set of essential and necessary knowledge for the physical understanding of the essentials of electrotechnical phenomena.

Recommended prior knowledge: Fundamental lessons in physical sciences acquired in the common core of science and technology.

Content of the material:

Chapter 1 – Electrical circuits **(4 weeks)**

1.1 Introduction
1.2 Current and voltage in electrical circuits
1.3 Resistors and equivalent circuit.
1.4 Work and power
1.5 Single-phase and three-phase electrical circuits.

Chapter 2 – Magnetic circuits **(3 weeks)**

2.1 Magnetism and electricity
2.2 Basic laws
2.3 Magnetic materials and circuits

Chapter 3 – The Transformers **(2 weeks)**

3.1 Description
3.2 Equivalent circuits
3.3 Instrument transformers
3.4 Special transformers

Chapter 4 – Electrical Machines **(3 weeks)**

4.1 Direct current machines (shunt, separate, and series excitation)
4.2 Synchronous machines
4.3 Asynchronous machines
4.4 Special machines
4.5 Connection of three-phase motors

Chapter 5 – Electrical Measurements **(3 weeks)**

5.1 Measurement in physics
5.2 Measurement quality – errors

5.3 Structure of digital display devices
5.4 Current and voltage measurements
5.5 Power and energy measurements
5.6 Wiring diagrams of an electrical installation - Calculation of wire section.

Evaluation method :
Review: 100%.

References:

- Exercises and problems in basic electrical engineering, networks and electrical machines; Luc Lasne; Dunod 2011 edition.
- Electrotechnics: modeling and simulation of electrical machines; Rachid Abdessemed; Ellipse 2011 edition.
- Electric circuits: continuous, sinusoidal and impulse regime, Jean-Paul Bancarel, Ellipse edition 2001.

Electrical Circuit Analysis, Charle K. Alexander and Matthew Sadiku; Boeck edition. 2012.

Semester: 6
Teaching unit: UEF 3.2.1
Subject: Physical metallurgy 2
VHS: 67h30 (Course: 3h00, tutorial: 1h30)
Credits: 6
Coefficient: 3

Teaching objectives:

This material covers in detail the iron-carbon diagram and the iron-cementite diagram. It deals with the structure of steel and cast iron as well as their different transformations. Finally, the different treatments of steel are exposed.

Recommended prior knowledge:

Physical metallurgy 1, production of ferrous metals.

Content of the material:

Chapter 1. Study of the Fe-C, Fe-Fe3C Equilibrium Diagram (1 week)

Chapter 2. Properties and Structure of steels and cast irons (1 week)

Chapter 3. Heating properties-Austenitization (2 weeks)

Austenitic grain size. Alpha-Gamma transformation (Slow, rapid heating, without maintenance, isothermal). Control of austenitic grain size. General information on TTT diagrams.

Chapter 4. Transformations of austenite in continuous cooling (3 weeks)

Methods proposed for the study of TRC. Influence of different factors on the shape and position of the TRC.

Influence of austenitization conditions. Martensitic transformation.

Chapter 5. Transformations during income **(1 week)**

Chapter 6. Hardenability of steels. **(1 week)**

Chapter 7. Thermal and thermomechanical treatments **(3 weeks)**

Chapter 8. Surface treatments: Mechanical, thermal and thermochemical **(3 weeks)**

Assessment method: Continuous assessment 40%; Exam 60%

Bibliographic references:

1. A. Constant, G.Henry, JC Charbonnier, Basic principles of thermal, thermomechanical and thermochemical treatments of steels.
2. Bénard, Elements of Physical Metallurgy.
3. Lakhtine, Physical metallurgy and heat treatments.
4. Precis of metallurgy

Semester: 6
Teaching unit: UEF 3.2.1
Subject: Corrosion and protection of metals VHS : 67h30 (Course: 3h00, tutorial: 1h30)
Crédits : 6
Coefficient : 3

Teaching objectives:

Identify the causes of metal corrosion. Learn the mechanisms and kinetics of corrosion. Learn metal protection techniques.

prerequisite knowledge:

Structure of matter S1, Thermodynamics S2.

Subject matter content:

Chapter I. Introduction and basics (3 weeks)

Economic importance of corrosion. Surface of materials-topography. Corrosion or redox reactions. Electrochemical batteries. Faraday's law.

Chapter II. Thermodynamics of corrosion reactions (3 weeks)

Electrochemical equilibrium: the standard potential of an electrode. Nernst's law. Diagrams Potential - Ph.

Chapter III. Electrochemical kinetics (3 weeks)

Polarization curves. Electrochemical techniques applied to corrosion. Impedance methods.

Chapter IV. Passivation (2 weeks)

Principle of passivation. Passive alloys.

Chapter V. The different forms of corrosion (2 weeks)

The different forms of aqueous corrosion and their mechanisms: Uniform corrosion.

Pitting corrosion. Crevice corrosion. Intergranular corrosion. Stress corrosion cracking. Galvanic corrosion. Selective corrosion. corrosion-erosion

Chapter VI. Protection against corrosion (2 weeks)

Alloys and areas of use. Surface treatments and coatings. Corrosion inhibitors. Cathodic protection. Paint

Assessment Method:

Continuous assessment: 40%; Exam: 60%.

Bibliographical References:

1-D.LANDOLDT : Corrosion et chimie de surface des métaux

Semester: 6
Unité d'enseignement : UEF 3.2.2
Subject: Special steels and alloys
VHS :45h (Course : 3h00)
Crédits : 4
Coefficient: 2

Teaching objectives:

This subject allows us to acquire knowledge concerning the classification of steels, the influence of addition elements on phase transformations in steels and special alloys and their repercussions on treatments and consequently on physicochemical properties, mechanical and technological aspects of these steels. These properties will largely determine the fields of application of these steels and alloys.

Prerequisite knowledge:

Production of ferrous metals. Physical metallurgy 1.

Subject matter content:

Chapter 1. Steel quality (3 weeks)

Concept of purity of steel, impurities (S and P), inclusionary cleanliness. Concepts of alloy elements: alphagenic, gammagenic, carburogenic and non-carburogenic elements.

Chapter 2. Phases in special steels and alloys (3 weeks)

Solid solutions. Transition metal carbides and nitrides. Intermetallic compounds.

Chapter 3. Particularities of phase transformations in special steels and alloys (4 weeks)

Formation of austenite during heating. Influence of addition elements on the stability of superfused austenite, TTT and TRC diagrams. Decomposition of austenite: Pearlitic transformation, Bainitic transformation, Martensitic transformation. Tempering of special steels and alloys: Effect of precipitation of carbides and intermetallics, recrystallization.

Chapter 4. Influence of additions on the treatments of special steels and alloys (3 weeks)

Construction steels. Low carbon steels for stamping, micro-alloy steels, dual-phase, improvement steels, cementation steels, and nitriding steels. Stainless, ferric, austenitic, martensitic steels.

Tool steels: Stamping, hot pressing, forging, machining steels, high-speed steels, cemented carbides.

Chapter 5. Special steels and superalloys (2 weeks)

Hadfield Steels

Marraging Steels

Refractory steels

Nickel-cobalt-based superalloys

Assessment Method

Exam: 100 %

Bibliographical References:

-Science et génie des matériaux, W.D. Callister

-Précis de métallurgie, J. Barralis, G. Maeder

Semester: 6
Teaching unit: UEF 3.2.2
Subject: Metal-Forming Processes
VHS: 10:30 p.m. (Course: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

Learn and know theoretically and practically the particularity of manufacturing mechanical parts by all the forming processes without removing the material.

Recommended prior knowledge:

Production of ferrous metals. Mechanical behavior of metals and alloys.

Content of the material:

Chapter 1. Continuous casting (4 weeks)

Introduction. Presentation of continuous casting. Continuous casting semi-finished products. Different types of continuous casting machines. Schematic diagram of a continuous casting machine. Operating process. Differentiation with ingot mold casting and continuous casting

Chapter 2. The foundry (3 weeks)

Introduction. General information about the foundry. The various foundry processes. Different foundry tools. Schematic diagram of manufacturing a part by the foundry. Operating process. Interest in manufacturing parts by the foundry.

Chapter 3. Powder metallurgy (4 weeks)

General. Sintering. Particularities of parts manufactured by powder metallurgy.
Powder manufacturing processes: Mechanical processes, Physico-chemical processes.
Cold compression forming of powder mixtures.
Processes for shaping a part using powder metallurgy.
Finishing of sintered parts.

Chapter IV. Drop forging (3 weeks)

Deformation conditions: Hot deformation. Cold deformation.
Forging.
Stamping and forging: Terminology and principles. Settings. Calculation of the draft.
Forging and stamping equipment.Areas of application.

Evaluation mode: 100% exam

Bibliographic references:

1. Jean DUFLOT **.** Ingots and ingot molds.engineering techniques.M 7,800
2. Joseph FARHI .article *Continuous casting of steel. Equipment. Operation* .M 7 812
3. Practical foundry manual, Copper, bronze, aluminum, various alloys. Jules Duponchelle. Primitive Emotion 2007
4. Art casting and foundry. Daniel Lambert Vial. 2002
5. Design and layout of cast steel parts. *Collective CTIF.2004*
6. Forging, Cutting, Stamping, Riveting, Stamping, Welding.René Champhy.2007
7. Metal. Shaping Forging and Welding. Jose Antonio. 2011
8. Powder metallurgy. Didier Bouvard.2002

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

Teaching objectives:

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

Recommended prior knowledge:

The entire Bachelor's program.

Content of the material:

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

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

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

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

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

Evaluation mode: Continuous **monitoring: 100%**

Bibliographic references :

Semester: 6
Teaching unit: UEM 3.2
Subject: PW Metal Forming Processes
VHS: 10h30(PW: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives:

Learn and know in a practical way the particularity of manufacturing metal parts by shaping processes without removing the material.

Recommended prior knowledge:

Metal shaping processes. Production of ferrous metals. Mechanical behavior of metals and alloys.

Content of the material:

(Depending on the resources available in the establishment)

1. Example on continuous casting
2. Casting of a part in an ingot mold
3. Introduction to manufacturing a part by the foundry
4. Powder preparation methods
5. Sintering practice
6. Manufacturing a part using powder metallurgy
7. Manufacturing a part by forging
8. Manufacturing a part by stamping

Evaluation mode: Continuous monitoring: 100%.

Bibliographic references:

Semester: 6
Teaching unit: UEM 3.2
Material: PW Thermal and thermochemical treatment of metals
VHS: 10h30 (PW: 2h30)
Credits: 3
Coefficient: 2

Teaching objectives:

Implement the main heat treatments and the main experimental techniques for the study of structural transformations of metal alloys. Highlight the changes in the properties and the valorization of the materials obtained at the end of the different treatments.

Recommended prior knowledge:

Physical chemistry S4, Mineralogy and crystallography, Physical metallurgy 2

Content of the material:

(Depending on the resources available in the establishment)

Practical work 1. Structural study of steel and cast iron
Practical work 2. Measuring the mechanical properties of steels and cast irons
Practical work 3. Annealing of steels (choice of temperature, cooling medium, structure and properties
Practical work 4. Jominy test (hardenability of steels)
Practical work 5. Quenching of ordinary and special steels (Choice of temperature, cooling medium, structure and properties)
Practical work 6. Tempering of ordinary and special steels (Choice of temperature, cooling medium, structure and properties)
Practical work 7. Surface treatments (case hardening, characterization of nitrocarburized layers,)

Evaluation mode: 100% control

Bibliographic references:

W. D. Callister. Materials science and engineering,

J. Barralis, G. Maeder. Precis of metallurgy,

A. Constant, G. Henry, JC Charbonnier. Basic principles of heat treatments,

C. Leroux. Guide to choosing heat treatments,

Semester: 6
Teaching unit: UED 3.2
Subject: Concepts of measurements and instrumentation
VHS: 10:30 p.m. (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:

Know the principle of measuring instruments. Know how to use instruments. Know the parameters influencing the quality of the results. Use computer tools to acquire and process data. Check the acceptability of the results. Identify sources of errors.

Recommended prior knowledge:

Mathematics L1 and L2. Physics 2. Metrology S3. Industrial Electricity2 S5.

Content of the material:

PART A: SENSOR METROLOGY

Chapter 1. Introduction to metrology (2 weeks)

Basic concepts; some definitions. The system of international units (SI) and its symbols. Multiples and submultiples of units. Links between SI units and Anglo-Saxon units.

Classification of sensors; Active sensors. Passive sensors. The quantities of influence.

The measuring chain.

Chapter 2. The dynamic characteristics of a sensor (1 week)

The zero order system. The first order system. The second order system

SECOND B: TEMPERATURE SENSORS

Chapter 3. Liquid expansion thermometers (2 weeks)

The liquid expansion thermometer; Description. Law of variation. Thermometric liquids.

Nature of the envelope. Emerging column.

Chapter 4. Gas expansion thermometers (1 week)

Principle. Description.

Chapter 5. Vapor pressure thermometers (1 week)

Principle. Filling liquids and areas of use.

Chapter 6. Solid **expansion thermometers (1 week)**

Principle. The bimetallic strip thermometer

Chapter 7. Electric thermometers (2 weeks)

Resistance thermometers; Principle. Metal selection criteria.

Thermistors; Principle of resistance-temperature relationship

Chapter 8. Thermocouples (3 weeks)

Principle.

Thermoelectric effects; The Peltier effect. The Thomson effect. The Seebeck effect.

Practical principles of using thermocouples.

Thermal sensitivity of a thermocouple.

Reference temperature of a thermocouple; The water and ice bath. The electric bridge method. The double oven method

Main types of thermocouples and limits of use

Comparison of thermocouples/electric thermometers.

Chapter 9. Dynamic response of a temperature sensor (2 weeks)

Introduction. Response to a step signal. Response to a ramp signal.

Evaluation method: Exam: 100%.

Bibliographic references:

G. ASCH et al. Sensors in industrial instrumentation. Edition DUNOD, Paris, 5th edition. (1998).
L. BERGOUGNOUX, Electronic Conditioning of Sensors, Polytechnique Marseille.
F. Baudoin and M. Lavabre. Sensors: Principles and uses, Edition CASTEILLA, (2007).

Semester: 6
Teaching unit: UED 3.2
Subject: Safety and environment
VHS: 10h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives:
Learn about the concepts of safety and the environment in the workplace.
Recommended knowledge:
Mathematics L1 and L2. Physics 2. Metrology S3. Industrial Electricity2 S5
Module content

Chapter 1. Organization of work safety (2 weeks)

Organization; internationally and nationally companies
Role of all actors in the organization of work safety: the health and safety commission; the safety service. the occupational doctor, the social worker. Workers… etc

Chapter 2. Work accidents and occupational diseases (2 weeks)

Definition of work accidents and occupational diseases;
Professional risks in the workplace.
Professional travel risks
Analysis of accidents work and occupational diseases
Cost of work accidents and occupational diseases
Classification of work accidents and occupational diseases
Choice of territory for an industrial company

Chapter 3. Workplace lighting (2 weeks)

Natural lighting.
Artificial lighting.
Mixed lighting
Noise and vibrations
Thermal radiation

Chapter 4. Ventilation and ventilation of workplaces

Natural ventilation
Artificial ventilation
Calculation of open and closed hosts

Chapter 5. Risks of electrocution and ionizing radiation (2 weeks)

Risk of electrocution.
Ionizing radiation;
Study of different ionizing radiations.
Means of detecting ionizing radiation.
Means of protection against ionizing radiation.

Chapter 6. Storage and decontamination of radioactive waste (2 weeks)
Chapter 7. Management of solid, liquid and gaseous waste **(2 weeks)**
Chapter 8. Toxicology **(1 week)**
Chemical risk assessment. Storage and intervention conditions
Evaluation method:

Exam: 100%.

Bibliographic references:

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

Teaching objectives:

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

Recommended prior knowledge:

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

Targeted skills:

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

Material content:

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

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

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

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

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

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

Chapter 4 - Finding a good business idea: **(2 Weeks)**

Creativity and innovation, Recognizing and evaluating business opportunities

Chapter 5–Lancere and running a business: **(3 Weeks)**

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

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

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

Evaluation method: Exam: 100%

References:

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

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

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

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

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

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

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

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

IV- Agreements / Conventions

STANDARD LETTER OF INTENT

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

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

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

The university (or university center) hereby declares to co-sponsor the license mentioned above throughout the license authorization period.

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

- Giving his point of view in the development and updating of teaching programs,
- Participating in seminars organized for this purpose,
- By participating in defense juries,
- By working to pool human and material resources.

SIGNATURE of the legally authorized person:

FUNCTION:

Date:

STANDARD LETTER OF INTENT

(If licensed in collaboration with a user sector company)

(Official company letterhead)

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

Provided to:

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

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

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

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

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

SIGNATURE of the legally authorized person:

FUNCTION:

Date:

OFFICIAL STAMP or COMPANY SEAL

V - Opinions and Visas from Administrative and Consultative Bodies

Title of the License: Metallurgy

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

VI – Opinion and Visa of the Regional Conference

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