



الجمهورية الجزائرية الديمقراطية الشعبية

People's Democratic Republic of
Algeria

وزارة التعليم العالي والبحث العلمي

Ministry of Higher Education and Scientific
Research

University

Logo



Training Offer L.M.D.

Academic LICENCE

**NATIONAL PROGRAM
2025
(3rdRevision)**

Establishment	Faculty / Institute	Departement

Domain	sector	Speciality
<i>Science and Technology</i>	<i>mechanical engineering</i>	<i>Construction mécanique</i>

Semester 1

Teaching unit	Subjects	Credits	Coefficient	Weekly hourly volume			Semestrial Hourly Volume (15 Weeks)	Additional Work in Consultation (15 Weeks)	Evaluation method	
	Title			Course	TuT	PW			Continuous Control	Exam
Fundamental unit Code: FUT 1.1.1 Credits: 10 Coefficients : 5	Analysis 1	6	3	1h30	3h00		67h30	82h30	40%	60%
	Algebra 1	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental Unit Code: FUT 1.1.2 Credits: 12 Coefficients: 6	Elements of Mechanics	6	3	1h30	3h00		67h30	82h30	40%	60%
	Structure of Matter	6	3	1h30	3h00		67h30	82h30	40%	60%
Methodological Unit Code : MUT 1.1 Credits : 6 Coefficients : 4	PW: Elements of Mechanics	2	1			1h30	22h30	22h30	100%	
	PW: Structure of Matter	2	1			1h30	22h30	22h30	100%	
	Computer Structure and Applications	2	2	1h30		1h00	37h30	22h30	40%	60%
Transversal unit Code : UET 1.1 Credits : 2 Coefficients : 2	Ethical and Professional Standards (Foundations)	1	1	1h30			22h30	02h30		100%
	Careers in Science and Technology	1	1	1h30			22h30	02h30		100%
Total semester 1		30	17	9h00	12h00	4h00	375h00	375h00		

Detailed program by subject

Fundamental unit**Code: FUT 1.1.1****Subjects 1: Analysis 1****WHV: 67h30 (Course: 1h30, TUT: 3h00)****Credits: 6****Coefficient: 3****Prerequisites:**

Basic mathematical concepts from the final year of secondary school (sets, functions, equations, etc.).

Learning Objectives

This first Analysis 1 course is primarily dedicated to standardizing students' knowledge upon entering university. New concepts are introduced progressively to guide students towards more advanced mathematics. The concepts covered in this course are fundamental and among the most widely used in the fields of Science and Technology.

Content of the material:Chapter 1: Properties of the set \mathbb{R}

Chapter 2: Real number sequences

Chapter 3: Real functions of a single variable

Chapter 4: Taylor series expansion

Chapter 5: Simple integrals

Assessment method:

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

- 1- K. Allab, Eléments d'analyse, Fonction d'une variable réelle, 1^{re}& 2^e années d'université, Office des Publications universitaires.
- 2- J. Rivaud, Algèbre : Classes préparatoires et Université Tome 1, Exercices avec solutions, Vuibert.
- 3- N. Faddeev, I. Sominski, Recueil d'exercices d'algèbre supérieure, Edition de Moscou

Fundamental unit**Code: FUT 1.1.1****Subjects: Algebra 1****WHV: 45h00 (Course: 1h30, TUT: 1h30)****Credits: 4****Coefficient: 2****Prerequisites:**

Basic mathematical concepts from the final year of secondary school (sets, functions, equations, etc.).

Teaching Objectives

This first Algebra I course is primarily dedicated to standardizing students' knowledge upon entering university. The initial new concepts are taught progressively to guide students towards more advanced mathematics. The concepts covered in this course are fundamental and among the most widely used in the fields of Science and Technology.

Content of the material:

Chapter 1: Sets, Relations, and Functions (**5 weeks**)

Chapter 2: Complex Numbers (**5 weeks**)

Chapter 3: Vector Spaces (**5 weeks**)

Assessment method:

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

1. J. Rivaud, Algèbre : Classes préparatoires et Université Tome 1, Exercices avec solutions, Vuibert.
2. N. Faddeev, I. Sominski, Recueil d'exercices d'algèbre supérieure, Edition de Moscou
3. M. Balabne, M. Duflo, M. Frish, D. Guegan, Géométrie – 2^e année du 1^{er} cycle classes préparatoires, Vuibert Université.
4. B. Calvo, J. Doyen, A. Calvo, F. Boshet, Exercices d'algèbre, 1^{er} cycle scientifique préparation aux grandes écoles 2^e année, Armand Colin – Collection U.

Fundamental Unit**Code: FUT 1.1.2****Subjects: Elements of Mechanics****WHV: 67h30 (Course: 1h30, TUT: 3h00)****Credits: 6****Coefficient: 3**

Prerequisites: A good grasp of basic physical sciences and mathematics in secondary school is recommended.

Objectives:

The teaching of this subject allows the student to acquire the fundamental notions of classical mechanics related to a point mass through:

- kinematics
- dynamics
- and the concepts of work and energy.

Content of the material:

Chapter 1: Review

Chapter 2: Kinematics

Chapter 3: Dynamics

Chapter 4: Rotational Motion

Chapter 5: Work, Power, Energy

Assessment method:

Continuous assessment: 40%, Final exam: 60%

Fundamental Unit**Code: FUT 1.1.2****Subjects: Structure of Matter****WHV: 67h00 (Course: 1h30, TUT: 3h00)****Credits: 6****Coefficient: 3****Recommended prior knowledge:** Basic knowledge of mathematics and general chemistry.**Teaching Objectives**

This course enables students to acquire fundamental chemical concepts, particularly those describing the atom and chemical bonding, chemical elements, and the periodic table with energy quantization. It also aims to equip students with the skills to solve chemistry problems.

Content of the material:Chapter 1: Fundamental Concepts (**2 Weeks**)Chapter 2: Main Constituents of Matter (**3 Weeks**)Chapter 3: Radioactivity – Nuclear Reactions (**2 Weeks**)Chapter 4: Electronic Structure of the Atom (**2 Weeks**)Chapter 5: Periodic Table of Elements (**3 Weeks**)Chapter 6: Chemical Bonding (**3 Weeks**)**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

1. Ouahes, Devallez, Chimie Générale, OPU.
2. S.S. Zumdhal & coll., Chimie Générale, De Boeck Université.
3. Y. Jean, Structure électronique des molécules : 1 de l'atome aux molécules simples, 3^e édition, Dunod, 2003.
4. F. Vassaux, La chimie en IUT et BTS.
5. A. Casalot & A. Durupthy, Chimie inorganique cours 2^{ème} cycle, Hachette.
6. P. Arnaud, Cours de Chimie Physique, Ed. Dunod.
7. M. Guymont, Structure de la matière, Belin Coll., 2003.
8. G. Devore, Chimie générale : T1, étude des structures, Coll. Vuibert, 1980.
9. M. Karapetiantz, Constitution de la matière, Ed. Mir, 1980.

Methodological Unit**Code: MUT 1.1****Subjects: PW: Elements of Mechanics****WHV: 22H30 (PW: 3h00)****Credits: 2****Coefficient: 1****Prerequisites:**

It is recommended that students have a solid grasp of basic physical sciences and mathematics from secondary school.

Objectives:

The teaching of this subject allows the student to acquire the fundamental notions of classical mechanics related to a point mass through:

- kinematics
- dynamics
- and the concepts of work and energy.

Physics1 Practical Works:

- Measurement and calculation of uncertainties
- Free fall
- Inclined plane
- Circular motion
- Simple pendulum
- Oscillating pendulum
- Solid-solid friction

Assessment method:

Continuous assessment: 100%

Methodological Unit**Code: MUT 1.1****Subjects:****PW: Structure of Matter****VHS: 22h30 (PW: 1h30)****Credits: 2****Coefficient: 1****Prerequisites:**

Basic concepts of mathematics and general chemistry.

Objectives:

Teaching this subject allows students to acquire basic chemical formalisms, particularly those describing the atom and chemical bonding, chemical elements, and the periodic table with energy quantization. It also aims to equip students with the skills to solve chemical problems.

Practical Works “Structure of Matter”**PW 1:** Preliminary Lab: Safety in the Chemistry Laboratory and Description of Equipment and Glassware.**PW 2:** Changes of State of Water: Transition from Liquid to Solid and from Liquid to Vapor.**PW 3:** Determination of the Amount of Substance.**PW 4:** Determination of Molecular Mass.**PW 5:** Uncertainty Calculation - Determination of Ionic Radius.**PW 6:** Determination of Partial Molar Volumes in a Binary Solution.**PW 7:** Qualitative Analysis of Cations (Groups 1, 2, 3, and 4)**PW 8:** Qualitative Analysis of Anions.**PW 9:** Identification of Metal Ions by the Flame Method.**PW 10:** Separation and Recrystallization of Benzoic Acid.**PW 11:** Construction and study of some compact structures.**PW 12:** Study of ionic structures**Assessment method:**

Continuous assessment: 100%

Bibliographical references:

1. Ouahes, Devallez, Chimie Générale, OPU.
2. S.S. Zumdhal & coll., Chimie Générale, De Boeck Université.
3. Y. Jean, Structure électronique des molécules : 1 de l'atome aux molécules simples, 3^e édition, Dunod, 2003.
4. F. Vassaux, La chimie en IUT et BTS.
5. A. Casalot & A. Durupthy, Chimie inorganique cours 2^{ème} cycle, Hachette.
6. P. Arnaud, Cours de Chimie Physique, Ed. Dunod.
7. M. Guymont, Structure de la matière, Belin Coll., 2003.
8. G. Devore, Chimie générale : T1, étude des structures, Coll. Vuibert, 1980.
9. M. Karapetiantz, Constitution de la matière, Ed. Mir, 1980.

Methodological Unit**Code: MUT 1.1****Subjects: Computer Structure and Applications****WHV: 45h00 (Course: 1h30, PW: 1h30)****Credits: 2****Coefficient: 2****Prerequisites:**

Basic concepts of Web technology.

Objectives:

The aim of this course is to enable students to learn to program using a high-level language (Fortran, Pascal, or C). The choice of language is left to the discretion of each institution. The concept of algorithms must be implicitly addressed during language learning.

Contents of the material:**Part 1. Introduction to Computer Science (5 Weeks)****Part 2. Concepts of Algorithms and Programs (10 Weeks)****Computer Practical works 1:**

The purpose of these labs is to illustrate the concepts taught during the lectures. They must begin with the lectures according to the following schedule:

- Introductory labs to familiarize students with the computer from a hardware and operating system perspective (exploration of the various functionalities of operating systems)
- Introductory labs to using a programming environment (Editing, Assembly, Compilation, etc.)
- Practical labs applying the programming techniques covered in the lectures.

Assessment method:

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

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

Transversal unit**Code: UET 1.11****Subjects: Ethical and Professional Standards (Foundations)****WHV: 22h30 (Course: 1h30)****Credits: 1****Coefficient: 1****Prerequisites:** None**Objectives:**

The main objective of this course is to facilitate an individual's immersion in student life and their transition to responsible adulthood. It aims to develop students' awareness of ethical principles, introduce them to the rules governing life at the university (their rights and obligations towards the university community) and in the professional world, raise awareness of the importance of respecting and valuing intellectual property, and explain the risks of moral failings such as corruption and how to combat them.

Contents of the material:**Chapter 1:** Fundamental Concepts (2 weeks)**Chapter 2:** Frameworks (2 weeks)**Chapter 3:** University Freedom (3 weeks)**Chapter 4:** University Values (2 weeks)**Chapter 5:** Rights and Responsibilities (2 weeks)**Chapter 6:** University Relations (2 weeks)**Chapter 7:** Practices (2 weeks)**Assessment method:**

Final exam: 100%

Bibliographical references:

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

Transversal unit**Code: UET 1.11****Subjects: Careers in Science and Technology****WHV: 22H30 (Course: 1h30)****Credits: 1****Coefficient: 1****Prerequisites:** None**Objectives:**

To introduce students, firstly, to all the fields of study covered by the Science and Technology domain, and secondly, to a range of careers that these fields lead to. In the same context, this subject introduces the emerging challenges of sustainable development and the new professions that may arise from it.

Contents of the material:**1. What are engineering sciences?**

The Engineering Profession: History and 21st-Century Challenges; Searching for a job/recruitment ad by keyword; Creating a simple job description (job title, company, main activities, required skills (knowledge, know-how, interpersonal skills)).

2. Fields of Study: Electronics, Telecommunications, Biomedical Engineering, Electrical Engineering, Electromechanics, Optics & Precision Mechanics:

- Definitions, areas of application (Home automation, embedded automotive applications, video surveillance, Mobile telephony, Fiber optics, Advanced scientific instrumentation, medical imaging and instrumentation, Giant mirrors, Contact lenses, Electrical power transmission and distribution, Power generation plants, Energy efficiency, Industrial equipment maintenance, Elevators, Wind turbines, etc.)
- Role of the specialist in these fields.

3. Fields of Study: Automation and Industrial Engineering:

- Definitions, areas of application (Automated industrial lines, Machine tools) Numerical Control, Robotics, Inventory Management, Goods Traffic Management, Quality – Role of the specialist in these fields.

4. Process Engineering, Hydrocarbons and Petrochemical Industries:

- Definitions, Pharmaceutical Industry, Food Processing Industry, Leather and Textile Industry, Biotechnology, Chemical and Petrochemical Industry, Plastics Processing, Energy Sector (Oil, Gas), ...
- Role of the specialist in these fields.

5. Industrial Health and Safety (IHS) and Mining Engineering:

- Definitions and areas of application (Safety of property and people, Environmental issues, Exploration and exploitation of mineral resources, ...)
- Role of the specialist in these fields.

6. HVAC and Transportation Engineering:

- Definitions, areas of application (Air conditioning, Smart buildings, Transportation safety, Management of Road, air, and naval traffic and transport, etc.)
- Role of the specialist in these fields.

7. Civil Engineering, Hydraulics, and Public Works Sectors: (2 weeks)

- Definitions and areas of application (Construction materials, Major Road and rail infrastructure, Bridges, Airports, Dams, Drinking water supply and sanitation, Hydraulic flows, Water resource management, Public Works and land development, Smart cities, etc.)
- Role of the specialist in these fields.

8. Aeronautics, Mechanical Engineering, Maritime Engineering, and Metallurgy Sectors:

- Definitions and areas of application (Aeronautics, Avionics, Automotive industry, Ports, Breakwaters, Industrial equipment production, Steel industry, Metal processing, etc.)
- Role of the specialist in these fields.

Group work: Develop job descriptions for professions within each sector based on recruitment advertisements found on job search websites (e.g., [http : //www.onisep.fr/Decouvrir-les-metiers](http://www.onisep.fr/Decouvrir-les-metiers), www.indeed.fr, www.pole-emploi.fr) (1 sector per group).

Depending on the institution's capacity, recommend involving doctoral students and alumni in a tutoring/mentoring program where each group can work with its tutor/mentor to develop the job description/explore the various professions within the ST (Science and Technology) sector.

Student work for this subject:

The instructor in charge of this subject may inform students that they can still be assessed by having them prepare career profiles. Students may also be asked to watch a popular science film related to their chosen career (after being provided with either the film electronically or via an internet link) and then submit a written report or give an oral presentation summarizing the film, etc. The weighting of these activities is left to the discretion of the instructor and the training team, who are solely responsible for determining the best way to incorporate this individual work into the overall final exam grade.

Assessment method:

Final exam: 100%

Bibliographical references:

- [1] Quels métiers pour demain ? Éditeur : ONISEP, 2016, Collection : Les Dossiers.
- [2] J. Douënel et I. Sédès, Choisir un métier selon son profil, Editions d'Organisation, Collection : Emploi & carrière, 2010.
- [3] V. Bertereau et E. Ratière, Pour quel métier êtes-vous fait ? Editeur : L'Étudiant, 6e édition, Collection : Métiers, 2015.
- [4] Le grand livre des métiers, Éditeur : L'Étudiant, Collection : Métiers, 2017.
- [5] Les métiers de l'industrie aéronautique et spatiale, Collection : Parcours, Edition : ONISEP, 2017.
- [6] Les métiers de l'électronique et de la robotique, Collection : Parcours, Edition : ONISEP, 2015.
- [7] Les métiers du bâtiment et des travaux publics, Collection : Parcours, Edition : ONISEP, 2016.
- [8] Les métiers du transport et de la logistique, Collection : Parcours, Edition : ONISEP, 2016.
- [9] Les métiers de l'énergie, Collection : Parcours, Edition : ONISEP, 2016.
- [10] Les métiers de la mécanique, Collection : Parcours, Edition : ONISEP, 2014.
- [11] Les métiers de la chimie, Collection : Parcours, Edition : ONISEP, 2017.
- [12] 12- Les métiers du Web, Collection : Parcours, Edition : ONISEP, 2015.

Semester 2

Teaching unit	Subjects	Credits	Coefficient	Weekly hourly volume			Semestrial Hourly Volume (15 WeeKs)	Additional Work in Consultation (15 WeeKs)	Evaluation method	
	Title			Course	TuT	PW			Continuous Control	Exam
Fundamental unit Code: FUT 1.2.1 Credits: 10 Coefficients : 5	Analysis 2	6	3	1h30	3h00		67h30	82h30	40%	60%
	Algebra 2	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental Unit Code: FUT 1.2.2 Credits: 12 Coefficients : 6	Electricity and Magnetism	6	3	1h30	3h00		67h30	82h30	40%	60%
	Thermodynamics	6	3	1h30	3h00		67h30	82h30	40%	60%
Methodological Unit Code : MUT 1.2 Crédits : 6 Coefficients : 4	PW: Electricity and Magnetism	2	1			1h30	22h30	22h30	100%	
	PW: Thermodynamics	2	1			1h30	22h30	22h30	100%	
	Introduction to Programming	2	2	1h30		1h00	37h30	22h30	40%	60%
Transversal unit Code : TUT 1.2 Credits: 2 Coefficients : 2	Free and Open-Source Software	2	2	1h30	1h30	45h00	05h00	40%	60%	
Total semester 2		30	17	9h00	10h30	5h30	375h00	375h00		

Detailed program by subject

Fundamental unit**Code: FUT 1.2.1****Subjects: Analysis 2****WHV: 67h30 (Course: 1h30, TUT: 3h00)****Credits: 6****Coefficient: 2****Prerequisites:**

It is recommended to have a solid grasp of the fundamental principles of integral calculus, antiderivatives, and the mathematics taught in the first semester (S1).

Objectives:

Of paramount importance for a scientist, this subject enables students to acquire:

- the methods for solving differential equations necessary for problems encountered in engineering and physics.
- the methods for calculating the differentiability and integrals of functions of several variables (surfaces, volumes), and the various forms of Taylor series expansions

Content of the material:**Chapter 1:** Ordinary Differential Equations**Chapter 2:** Functions of Several Variables. Concepts of Limit, Continuity, Partial Derivatives, Differentiability**Chapter 3:** Integrals**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

- [1] Kada Allab, *Eléments d'Analyse*. Office des publications Universitaires. Ben Aknoun. Alger 1984
- [2] N. Piskounov, *Calcul différentiel et integral*. Editions Mir. Moscou 1978
- [3] J. Dixmier, *Cours de mathématiques du premier cycle*. 1ère année. Gauthiers-Villars. Paris 1976
- [4] R. Murray Spiegel. *Théorie et applications de l'Analyse*. McGraw-Hill, Paris 1973
- [5] G. Flory, *Topologie, Analyse. Exercices avec solutions*. Vuibert. Paris 1978

Fundamental unit**Code: FUT 1.2.1****Subjects: Algebra 2****WHV: 45h00 (Course: 1h30, TUT: 1h30)****Credits: 4****Coefficient: 2****Prerequisites:**

Algebra 1

Objectives:

- To consolidate the knowledge acquired in the first semester.
- To study new concepts: sum of several vector subspaces, stable subspaces, trace.
- To move between geometric and matrix representations and vice versa.

Content of the material:**Chapter 1:** Vector Spaces**Chapter 2:** Linear Transformations**Chapter 3:** Matrices, Related Matrices, and Determinants**Chapter 4:** Systems of Linear Equations**Chapter 5:** Matrix Reduction**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

- [1] A.KUROSH : Cours d'algèbre supérieure. Edition MIR MOSCOU.
- [2] D.FADEEV et I.SOMINSKY : Recueil d'exercices d'algèbre supérieure. Edition MIR MOSCOU.
- [3] J.RIVAUD : Exercices avec solutions tome 1 VUIBERT.
- [4] J.RIVAUD : Exercices avec solutions tome 2 VUIBERT.
- [5] LEBSIR HABIB : Travaux dirigés d'algèbre générale. Dar el-houda Ain M'LILA.
- [6] Jean-Pierre Escofier : Toute l'algèbre de la licence. Cours et exercices corrigés. Dunod.
- [7] J.Lelong-Ferrand, J.M.Arnaudiès : Cours de mathématiques. Tome 1 Algèbre 3^eédition. Classes préparatoires 1^{er}cycle universitaire. Dunod.
- [8] A.DONEDDU : ALGEBRE ET GEOMETRIE 7 Mathématiques spéciales Premier cycle universitaire. VUIBERT.
- [9] COLLET Valérie : MATHS Toute la deuxième année. ellipses

Fundamental Unit**Code: FUT 1.2.2****Subjects: Electricity and Magnetism****WHV: 67h30 (Course: 1h30 – TUT 3h00)****Credits: 6****Coefficient: 3****Prerequisites:**

- Concepts of vector and scalar fields.
- Concepts of vector calculus.
- Electric charges.

Objectives :

- Identify the sources of electric and magnetic fields.
- Calculate and differentiate between vector and scalar fields.
- Calculate the electric field and potential produced by a charge distribution.
- Calculate the magnetic field produced by an electric current.

Content of the material:**Chapter 1:** Electrostatic Field and Potential**Chapter 2:** Conductors**Chapter 3:** Electric Current**Chapter 4:** Magnetostatics**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

- Physique, 2. Electricité et magnétisme, Harris Benson, éditions de Boeck.
- Physique, 2. Electricité et magnétisme, Eugene Hecht, éditions de Boeck.
- Physique Générale, Electricité et magnétisme, Douglas Giancoli, éditions de Boeck

Fundamental Unit**Code: FUT 1.2.2****Subjects: Thermodynamics****WHV: 67h30 (Course: 1h30, TUT: 3h00)****Credits: 6****Coefficient: 3****Objectives:**

The acquired knowledge allows for the characterization of the behavior of liquid, solid, and gaseous substances and the evaluation of their thermodynamic properties under different conditions (temperature, pressure, pure elements, ideal mixtures, and phase changes).

Content of the material:**Chapter 1:** Basic Concepts in Thermodynamics**Chapter 2:** Thermodynamic Properties of Pure Substances**Chapter 3:** Fundamental Concepts of Thermodynamics**Chapter 4:** Equilibria of Physical Processes**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

- [1] Smith, E.B, Basic Chemical Thermodynamics, 2nd ed., Clarendon Press, Oxford, 1977.
- [2] Rossini, F. D., Chemical Thermodynamics, Wiley, New York, 1950. Florence,
- [3] Stanley I.Sandler, Chemical and Engineering Thermodynamics, Wiley, New York, 1977.
- [4] Elliot, J, Lira C.T, Introductory chemical engineering Thermodynamics , Prentice –Hall (1999)
- [5] Lewis G.N., Randal M., Thermodynamics, Mac Graw Hill
- [6] Hougen O.A., Watson K.M., Chemical process principles, Vol II: thermodynamics John Wiley and sons

Methodological Unit**Code: MUT 1.2****Subjects: PW: Electricity and Magnetism****WHV: 45h00 (PW: 1h30)****Credits: 2****Coefficient: 1****Prerequisites:**

Mathematics 1, Physics 1.

Objectives :

Consolidate the theoretical concepts covered in the Physics 2 course through practical work sessions.

Content of the material:**5 manipulations minimum (3h00 / 15 days)**

- Presentation of measuring instruments and tools (voltmeter, ammeter, rheostat, oscilloscopes, generator, etc.).
- Kirchhoff's laws (loop law, node law).
- Thevenin's theorem.
- Association and measurement of inductances and capacitances
- Charging and discharging a capacitor
- Oscilloscope
- Practical work on magnetism

Assessment method:

Continuous assessment: 100%

Methodological Unit**Code: MUT 1.2****Subjects: PW: Thermodynamics****WHV: 22h30 (TP: 3h00)****Credits: 2****Coefficient: 1****Prerequisites:** None**Objectives:**

The acquired knowledge allows for the characterization of the behavior of liquid, solid, and gaseous substances and the evaluation of their thermodynamic properties under different conditions (temperature, pressure, pure elements, ideal mixtures, and phase changes).

Thermodynamics Practical Work:

PW 1: Study of the equation of state of an ideal gas.

PW 2: Water content of the calorimeter.

PW 3: Specific heat capacity: specific heat capacity of liquids and solids.

PW 4: Study of the solidification of pure water.

PW 5: Latent heat: Latent heat of fusion of ice.

PW 6: Determination of the latent heat of vaporization.

PW 7: Heat of reaction: Determination of the energy released by a chemical reaction (HCl/NaOH).

PW 8: Thermodynamic functions of an acid-base equilibrium.

PW 9: Study of the variation of pressure as a function of temperature at equilibrium (l-g) for a pure system: water.

PW 10: Vapor pressure of a solution

PW 11: Equilibrium diagram for a binary system.

PW 12: Equilibrium diagram for a ternary system.

Assessment method:

Continuous assessment: 100%,

Methodological Unit**Code: MUT 1.2****Subjects: Introduction to Programming****WHV: 45h00 (Course: 1h30, PW: 1h30)****Credits: 2****Coefficient: 2****Prerequisites:**

- No prior programming experience is required
- Basic math skills (high school level)
- Basic computer skills
- Basic knowledge of an operating system

Objectives :

- Acquire fundamental programming skills
- Master the syntax and structures of the C language
- Understand basic algorithmic concepts
- Develop problem-solving skills through programming
- Implement functional programs in C
- Acquire best practices in programming and code documentation

Content of the material:**Chapter 1:** Introduction to Computer Science and Programming (1 week)**Chapter 2:** Structure of a C Program and Data Types (2 weeks)**Chapter 3:** Input/Output and Expressions (2 weeks)**Chapter 4:** Conditional and Iterative Control Structures (3 weeks)**Chapter 5:** Functions, Arrays, and Strings (3 weeks)**Chapter 6:** Pointers and Dynamic Allocation (2 weeks)**Chapter 7:** Structures and Enumerations (2 weeks)**Detailed content of the practical sessions****Practical Session 1:** Getting started with the environment**Practical Session 2:** Variables and expressions**Practical Session 3:** Conditional structures and iterative structures**Practical Session 4:** Functions**Practical Session 5:** One-dimensional and multi-dimensional arrays**Practical Session 6:** Character strings**Practical Session 7:** Pointers and dynamic allocation**Practical Session 8:** Files**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

1. Kernighan, B. W., & Ritchie, D. M. (2022). *Le langage C : Norme ANSI*, 2e édition. Dunod.
2. Perry, G. (2007). Exercices corrigés sur le Langage C, 2e édition . Dunod.
3. Delannoy, C. (2016). *Programmer en langage C : Cours et exercices corrigés*, 5^{eme} édition. Eyrolles.

4. Tanenbaum, A. S. (2008). Systèmes d'exploitation Avec plus de 400 exercices, 3e édition. Pearson.
5. Yves, M. (2009). C en action Solutions et exemples pour les programmeurs en C, 2^e édition, ENI, ISBN10 : 2746052563.
6. Ressources en ligne :
 - *Learn C Programming* sur <https://www.learn-c.org/>
 - *C Programming* sur <https://www.tutorialspoint.com/cprogramming/>

Transversal unit**Code: TUT 1.2****Subjects: Free and Open-Source Software****WHV:45h00 (Course: 1h30 & Workshop: 1h30)****Credits: 2****Coefficient: 2****Objectives:**

This course aims to familiarize students with the free and open-source software ecosystem, its philosophical and technical foundations, and its practical application to replace proprietary solutions.

Upon completion of this course, students will be able to:

- Understand the fundamental concepts of free and open-source software
- Master the main free licenses and their legal implications
- Identify and use free alternatives to common proprietary software
- Install and configure free solutions adapted to the Algerian context
- Adopt an ethical and collaborative approach to software development

Content of the material:**Chapter 1:** Foundations of Free Software (2 weeks)**Chapter 2:** Legal Framework and Licenses (2 weeks)**Chapter 3:** Free Operating Systems (3 weeks)**Chapter 4:** Free Office Solutions (3 weeks)**Chapter 5:** Creative Solutions and Development (3 weeks)**Chapter 6:** Prospects and Future of Free Software (2 weeks)**Workshops****Workshop 1:** Introduction to Linux**Workshop 2:** Software Management under Linux**Workshop 3:** Migrating to LibreOffice**Workshop 4:** Free Spreadsheets and Presentations**Workshop 5:** Image Processing and Graphics**Workshop 6:** Web and Free Databases**Workshop 7:** Collaborative Development**Assessment method:**

Final exam: 100%

Bibliographical references:

1. Stallman, R. (2002). "Free as in Freedom : Richard Stallman's Crusade for Free Software", 1st Edition, O'Reilly Media.
2. Mathieu, N. (2012). " Reprenez le contrôle à l'aide de Linux - 2e édition". EYROLLES.
3. Stutz, M. (2001). " The Linux Cookbook: Tips and Techniques for Everyday". No Starch Press.
4. Collectif Eni. (2009). " Initiation aux logiciels libres OpenOffice.org 3, Firefox 3 et Thunderbird". ENI Editions.
5. François, E. (2009). "L'économie du logiciel libre". EYROLLES.
6. Marie, C. (2014). " Des logiciels libres pour le Maghreb ? Des opportunités théoriques aux réalités empiriques ". Institut de recherche sur le Maghreb contemporain.
1. Documentation du projet GNU: <https://www.gnu.org/doc/doc.html>

2. Stallman, R. M. (2002). *Free Software, Free Society: Selected Essays of Richard M. Stallman*. GNU Press

Semester 3

Teaching unit	Subjects	Credits	Coefficient	Weekly hourly volume			Semestrial Hourly Volume (15 WeeKs)	Additional Work in Consultation (15 WeeKs)	Evaluation method	
	Title			Course	TuT	PW			Continuous Control	Exam
Fundamental unit Code: FUT 2.1.1 Credits: 10 Coefficients : 5	Analysis 3	6	3	1h30	3h00		67h30	82h30	40%	60%
	Waves and Vibrations	4	2	1h30	1h30		45h00	45h00	40%	60%
Fundamental Unit Code: FUT 2.1.2 Credits: 9 Coefficients : 5	Fluid Mechanics 1	5	3	1h30	1h30	1h30	67h30	82h30	40% (20%TD+20%TP)	60%
	Rational Mechanics	4	2	1h30	1h30		45h00	45h00	40%	60%
Methodological Unit Code : MUT 2.1 Credits: 10 Coefficients : 6	Probability and Statistics	4	2	1h30	1h30		45h00	45h00	40%	60%
	Python Programming	2	2	1h30		1h30	45h00	27h30	40%	60%
	Technical Drawing	2	1			1h30	22h30	27h30	100%	
	PW: Waves and Vibrations	2	1			1h00	22h30	17h50	100%	
	Metrology	1	1	1h30			22h30	02h30		100%
Total semester 3		30	17	10h30	9h00	5h30	375h00	375h00		

Detailed program by subject

Fundamental unit**Code: FUT 2.1.1****Subjects: Analysis 3****WHV: 67h30 (Course: 1h30, TD: 3h00)****Credits: 6****Coefficient: 3**

Prerequisites: It is recommended to master the fundamental principles of integral calculus and antiderivatives of functions of several variables, as well as the mathematics taught in S1 and S2.

Objectives :

Of paramount importance for a scientist, this subject allows the student to acquire:

- The use of vector analysis for describing several physical and practical phenomena
- Mastery of the Fourier transform for the most common applications
- Mastery of the Laplace transform for solving differential equations and systems of differential equations

Course Content**Chapter 1:** Vectorial Analysis**Chapter 2:** Numerical and Power Series**Chapter 3:** Fourier Series**Chapter 4:** Fourier and Laplace Transforms**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

1. Med El Amrani, Suites et séries numériques, Ellipses.
2. François Liret ; mathématiques en pratiques, cours et exercices; Dunod. (f.p.v ; Int. Mult. Séries...)
3. Marc Louis, Maths MP-MP, Ellipses. (Int. Doubles)
4. Denis Leger, PSI. Exercices corrigés Maths, Ellipses. (Séries de Fonctions, Entières, Fourier...)
5. Charles-Michel Marle, Philippe Pilibossian, Sylvie Guerre- Delabrière, Ellipse. (Suites, Séries, Intégrales).
6. Fabrice Lembiez Nathan, Tout en un, Exercices de maths.
7. Valerie Collet, Maths toute la deuxième année, 361 exercices, rappels de cours, trucs et astuces, ellipses.
8. A.Monsouri, M.K.Belbarki. Elément d'analyse. Cours et exercices résolus. 1^{er} cycle universitaire. Chiheb. (Intégrales doubles et triples, Séries, Transformations de Fourier et de Laplace, Equations aux dérivées partielles du 2^{ième} ordre).
9. B.DEMIDOVITCH. Recueil d'exercices et de problèmes d'analyse mathématiques. 11^{ième} édition. Ellipses. (Fonctions de plusieurs variables, Séries, Intégrales multiples)

Fundamental unit**Code: FUT 2.1.1****Subjects: Waves and Vibrations****WHV: 45h00 (Course: 1h30, TUT: 1h30)****Credits: 4****Coefficient: 2****Prerequisites:** Mathematics 2, Physics 1 and Physics 2**Objectives :**

To 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.

Course Content**Part A: Vibrations****Chapter 1:** Introduction to Lagrange's Equations **(2 weeks)****Chapter 2:** Free Oscillations of Systems with One Degree of Freedom **(2 weeks)****Chapter 3:** Forced Oscillations of Systems with One Degree of Freedom **(1 week)****Chapter 4:** Free Oscillations of Systems with Two Degrees of Freedom **(1 week)****Chapter 5:** Forced Oscillations of Systems with Two Degrees of Freedom **(2 weeks)****Part B: Waves****Chapter 1:** One-Dimensional Propagation Phenomena **(2 weeks)****Chapter 2:** Vibrating Strings **(2 weeks)****Chapter 3:** Acoustic Waves in Fluids **(1 week)****Chapter 4:** Electromagnetic Waves **(2 weeks)****Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

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

Fundamental Unit**Code: FUT 2.1.2****Subjects: Fluid Mechanics 1****WHV: 67h30 (Course: 1h30, TUT: 1h30, PW :1h30)****Credits: 5****Coefficient: 3****Objectives:**

The first part introduces the student to the field of fluid mechanics; fluid statics will be detailed. The second part will then consider the study of the motion of inviscid fluids, and finally, the motion of real fluids will be studied.

Course Content**Chapter 1: Properties of Fluids (3 weeks)****Chapter 2: Fluid Statics (4 weeks)****Chapter 3: Dynamics of Ideal Incompressible Fluids (4 weeks)****Chapter 4: Dynamics of Real Incompressible Fluids (4 weeks)****Practical works:****PW 1.** Viscometer**PW 2.** Determination of Linear and Singular Head Losses**PW 3.** Flow Rate Measurement**PW 4.** Water Hammer and Mass Oscillations**PW 5.** Verification of Bernoulli's Theorem**PW 6.** Jet Impact**PW 7.** Flow Through an Orifice**PW 8.** Visualizing Flow Around an Obstacle**PW 9.** Determining the Reynolds Number: Laminar and Turbulent Flow**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

- 1- Fundamentals of fluid mechanics 6th Edition, 2009, BR Munson, DF Young TH Okiishi, WW Huebsch 6th 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- Mécanique des fluides et hydraulique 2^{ème} édition, Ronald v. Giles, Jack B Evett, Cheng Liu, McGraw-Hill
- 5- S. Amiroudine, J. L. Battaglia, 'Mécanique des fluides Cours et exercices corrigés'Ed. Dunod
- 6- R. Comolet, 'Mécanique des fluides expérimentale', Tome 1, 2 et 3, Ed. Masson et Cie.
- 7- R. Ouziaux, 'Mécanique des fluides appliquée', Ed. Dunod, 1978

- 8- B. R. Munson, D. F. Young, T. H. Okiishi, 'Fundamentals of fluid mechanics', Wiley & sons.
R. V. Gilles, 'Mécanique des fluides et hydraulique : Cours et problèmes', Série Schaum,
Mc Graw Hill, 1975.

Fundamental Unit**Code: FUT 2.1.2****Subjects: Rational Mechanics****WHV: 45h00 (Course: 1h30, TUT: 1h30)****Credits: 4****Coefficient: 2**

Prerequisites: The student must first assimilate Physics 1, which deals with point mechanics. Also, Mathematics 2 contains essential tools.

Objectives:

The student will be able to understand the nature of a problem (static, kinematic, or dynamic) in solid mechanics, and will possess the tools to solve the problem within the framework of classical mechanics. This course is a prerequisite for the courses: Strength of Materials and Analytical Mechanics.

Course Content**Chapter 1:** Mathematical Review (Elements of Vector Calculus). **(1 week)****Chapter 2:** Generalities and Basic Definitions. **(2 weeks)****Chapter 3:** Statics. **(3 weeks)****Chapter 4:** Kinematics of Rigid Bodies. **(3 weeks)****Chapter 5:** Mass Geometry. **(3 weeks)****Chapter 6:** Dynamics of Rigid Bodies. **(3 weeks)****Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

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

1. Éléments de Mécanique rationnelle. S. Targ. Editions Mir Moscou
2. Mécanique à l'usage des ingénieurs. STATIQUE. Edition Russell. Ferdinand P. Beer
3. Mécanique générale. Cours et exercices corrigés. Sylvie Pommier. Yves Berthaud. DUNOD.
4. Mécanique générale - Théorie et application, Editions série. MURAY R. SPIEGEL schaum, 367p.
5. Mécanique générale – Exercices et problèmes résolus avec rappels de cours, Office des publications Universitaires, Tahar HANI 1983, 386p.

Methodological Unit**Code: MUT 2.1****Subjects: Probability and Statistics****WHV: 45h00 (Course: 1h30, TUT: 1h30)****Credits: 4****Coefficient: 2****Prerequisites: Mathematics 1 and Mathematics 2****Objectives:**

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

Course Content**Part A: Statistics****Chapter 1: Basic Definitions (1 week)****Chapter 2: Statistical Series with One Variable (3 weeks)****Chapter 3: Statistical Series with Two Variables (3 weeks)****Part B: Probability****Chapter 1: Combinatorial Analysis (1 week)****Chapter 2: Introduction to Probability (2 weeks)****Chapter 3: Conditioning and Independence (1 week)****Chapter 4: Random Variables (1 week)****Chapter 5: Common Discrete and Continuous Probability Distributions (3 weeks)****Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

1. D. Dacunha-Castelle and M. Duflo. Probabilités et statistiques : Problèmes à temps fixe. Masson, 1982.
2. J.-F. Delmas. Introduction au calcul des probabilités et à la statistique. Polycopié ENSTA, 2008.
3. W. Feller. an Introduction to Probability Theory and its Applications, Volume 1. Wiley & Sons, Inc., 3rd edition, 1968.
4. G. Grimmett, D. Stirzaker, Probability and Random Processes, Oxford University Press, 2nd edition, 1992.
5. J. Jacod and P. Protter, Probability Essentials, Springer, 2000.
6. A. Montfort. Cours de statistique mathématique. Economica, 1988.
7. A. Montfort. Introduction à la statistique. Ecole Polytechnique, 1991

Methodological Unit**Code: MUT 2.1****Subjects: Python Programming****WHV: 45h00 (Course: 1h30, TUT: 1h30)****Credits: 2****Coefficient: 2****Prerequisites:**

- No prior programming experience is required.
- Basic math skills (high school level).
- Basic computer skills (file navigation, text editor).

Objectives:

- Acquire the practical foundations of programming with Python
- Develop algorithmic logic to solve simple problems
- Learn to manipulate fundamental data structures
- Know how to write, test, and debug basic Python programs
- Apply programming concepts to practical cases

Course Content**Chapter 1.** Installing and Using Python**Chapter 2.** Basic Concepts**Chapter 3.** Conditional Structures**Chapter 4.** Loops**Chapter 5.** Functions**Chapter 6:** Lists and Tuples**Chapter 7:** Dictionaries**Chapter 8:** Objects and Classes**Chapter 9:** Files**Practical Works:****PW 1:** Getting Started with the Python Environment (1 Week)**PW 2:** Variables, Data Types, and Operations (1 Week)**PW 3:** Conditional and Repetitive Structures (1 Week)**PW 4:** Functions and Modularity (1 Week)**PW 5:** Data Structures (1 Week)**PW 6:** File Manipulation and Final Project (1 Week)**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

- [1] . Allen B. Downey Think Python: How to Think Like a Computer Scientist, O'Reilly Media, 2015;
- [2] . Ramalho, L.. Fluent Python. " O'Reilly Media, Inc.", 2022;

- [3] .Swinnen, G.. Apprendre à programmer avec Python 3. Editions Eyrolles, 2012;
- [4] .Matthes, E. Python crash course: A hands-on, project-based introduction to programming. no starch press, 2019
- [5] .Cyrille, H. (2018). Apprendre à programmer avec Python 3. Eyrolles, 6ème édition. ISBN: 978-2212675214
- [6] .Daniel, I. (2024). Apprendre à coder en Python, J'ai lu
- [7] .Nicolas, B. (2024). Python, du grand débutant à la programmation objet Cours et exercices corrigés, 3eme édition, Ellipses
- [8] .Ludivine, C. (2024). Selenium Maîtrisez vos tests fonctionnels avec Python, Eni

Ressources en ligne :

- Documentation officielle Python : docs.python.org
- Exercices Python sur Codecademy : [codecademy.com/learn/learn-python-3](https://www.codecademy.com/learn/learn-python-3)
- W3Schools Python Tutorial : [w3schools.com/python/](https://www.w3schools.com/python/)

Methodological Unit**Code: MUT 2.1****Subjects: Technical Drawing****WHV: 22h30 (PW: 1h30)****Credits: 2****Coefficient: 1**

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

Objectives:

This course will enable students to acquire the principles of representing parts in technical drawing. Furthermore, this subject will allow students to represent and read blueprints.

Course Content**Chapter 1: Generalities. (2 Weeks)****Chapter 2: Elements of Descriptive Geometry. (6 Weeks)****Chapter 3: Perspectives. (2 Weeks)****Chapter 4: Cuts and Sections. (2 Weeks)****Chapter 5: Dimensioning. (2 Weeks)****Chapter 6: Concepts of Detail and Assembly Drawings and Parts Lists. (1 Week)**

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

Assessment method:

Continuous assessment: 100%

Bibliographical references:

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

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

Methodological Unit**Code: MUT 2.1****Subjects: PW: Waves and Vibrations****WHV: 22h30 (PW: 1h30)****Credits: 2****Coefficient: 1****Prerequisites:** Vibrations and waves, Mathematics 2, Physics 1, Physics 2.**Objectives:**

The objectives assigned by this program focus on introducing students to the practical application of knowledge received on mechanical vibration phenomena restricted to low amplitude oscillations for one or two degrees of freedom, as well as the propagation of mechanical waves.

Contenu de la matière :**PW 1** Mass-Spring**PW 2** Simple Pendulum**PW 3** Torsion Pendulum**PW 4** Oscillating Electrical Circuit in Free and Forced Regimes**PW 5** Coupled Pendulums**PW 6** Transverse Oscillations in Vibrating Strings**PW 7** Grooved Pulley according to Hoffmann**PW 8** Electromechanical Systems (The Electrodynamic Loudspeaker)**PW 9** Pohl's Pendulum**PW 10** Propagation of Longitudinal Waves in a Fluid**Note:** It is recommended to choose at least 5 practical exercises from the 10 offered.**Assessment method:**

Continuous assessment: 100%

Bibliographical references:

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

Methodological Unit**Code: MUT 2.1****Subjects: Metrology****WHV: 22h30 (Course: 1h30)****Credits: 1****Coefficient: 1****Prerequisites:** Trigonometry, optics and other things.**Objectives:**

To teach the student the criteria for precision in the manufacturing and assembly of parts; To know and be able to choose, in different cases, the methods and means of control and measurement of the dimensions and manufacturing defects of mechanical parts.

Course Content**Chapter 1:** Generalities on Metrology **(2 weeks)****Chapter 2:** The International System of Units (SI) **(3 weeks)****Chapter 3:** Metrological Characteristics of Measuring Instruments **(6 weeks)****Chapter 4:** Measurement and Control **(4 weeks)****Assessment method:**

Final exam: 100%

Bibliographical references:

- 1- Manuel de technologie mécanique, Guillaume SABATIER, et al Ed. Dunod.
- 2- Memotech : productique matériaux et usinage BARLIER C. Ed. Casteilla
- 3- Sciences industrielles MILLET N. ed. Casteilla
- 4- Memotech : Technologies industrielles BAUR D. et al , Ed. Casteilla
- 5- Métrologie dimensionnelle CHEVALIER A. Ed. Delagrave
- 6- Perçage , fraisage JOLYS R et LABELL R. Ed. Delagrave
- 7- Guide des fabrications mécaniques PADELLA P. Ed. Dunod
- 8- Technologie : première partie, Bensaada S et FELIACHI d. Ed. OPU Alger
- 9- تكنولوجيا عمليات التصنيع خريز و فواز د. ديوان المطبوعات الجامعية الجزائر

Semester 4

Teaching unit	Subjects	Credits	Coefficient	Weekly hourly volume			Semestrial Hourly Volume (15 WeeKs)	Additional Work in Consultation (15 WeeKs)	Evaluation method	
	Title			Course	TuT	PW			Continuous Control	Exam
Fundamental unit Code : FUT 2.2.1 Credits: 6 Coefficients : 3	Thermodynamics 2	4	2	1h30	1h30		45h00	55h00	40%	60%
	Mechanical Manufacturing	2	1	1h30			22h30	27h30		100%
Fundamental Unit Code: FUT 2.2.2 Credits: 10 Coefficients : 5	Complex Analysis	4	2	1h30	1h30		45h00	55h00	40%	60%
	Strength of Materials 1	4	2	1h30	1h30		45h00	55h00	40%	60%
	Industrial Electricity	2	1	1h30			22h30	27h30		100%
Methodological Unit Code : MUT 2.2 Credits: 11 Coefficients : 6	Numerical Methods	5	3	1h30	1h30	1h30	67h30	82h30	40% (20%TD+20%TP)	60%
	Computer-Aided Design	2	1			1h30	22h30	27h30	100%	
	PW: Strength of Materials	2	1			1h00	15h00	10h00	100%	
	PW: Mechanical Manufacturing	2	1			1h30	22h30	27h30	100%	
Discovery unit Code: DUT 2.2 Credits: 1 Coefficients: 1	Materials Science	1	1	1h30			22h30	02h30		100%
Transversal unit Code : TUT 2.2 Credits: 2 Coefficients : 2	Information and Communication Technologies	2	2	1h30	1h30 d'atelier	45h30	5h00	40%	60%	
Total semester 4		30	17	12h00	6h00	7h00	375h00	375h00		

Detailed program by subject

Fundamental unit**Code: FUT 2.2.1****Subjects: Thermodynamics 2****WHV: 45h00 (Course: 1h30, TUT: 1h30)****Credits :4****Coefficient: 2****Prerequisites:** Thermodynamics of S2, Basic Mathematics.**Objectives:**

To establish the general principles of thermodynamics and highlight their applications in engineering sciences. The objective is to enable students to analyze energy systems using the prerequisites from the first year, to demonstrate the necessary steps for studying water vapor, and to introduce the study of heat and cooling cycles.

Content of the material:**Chapter 1:** Review of Basic Thermodynamic Concepts **(1 week)****Chapter 2:** Thermodynamic Properties of Pure Substances **(2 weeks)****Chapter 3:** Thermodynamics of Vapors and Humid Air **(2 weeks)****Chapter 4:** Gas Compression **(2 weeks)****Chapter 5:** Gas Expansion **(2 weeks)****Chapter 6:** Engine Cycles **(3 weeks)****Chapter 7:** Refrigeration Cycles **(3 weeks)****Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

1- Y. CENGEL, M. A. BOLES, 'Thermodynamique, une approche pragmatique', Edition De Boeck, la Chenelière, 2008 . Traduit de l'anglais par M. Lacroix de 'Thermodynamics, an Engineering approach'.

2- Andre HOUBERECHTSLa thermodynamique technique, tomes 1 et 2

3- SONNTAG et VAN WYLEN, 'Thermodynamique et applications', traduit de l'anglais, Fundamentals of classical thermodynamics' ed. Mc Graw Hill.

4- G. BRUHAT, Revue et augmenté par A. KASTLER, 'Thermodynamique', Edition 6, Masson & Cie.

5- R. Kling, 'Thermodynamique et applications', Edition Technip.

6- M. J. MORAN and HOWARD M. SHAPIRO, Fundamentals of engineering Thermodynamic', J. Wiley & sons editors, 2006.

7- RAPIN-JACQUARD Installations frigorifiques (technologie), Edition Dunod; 2004

8- J. P. PEREZ 'Thermodynamique: Fondements et applications', Dunod, Paris 2001.

Fundamental unit**Code: FUT 2.2.1****Subjects: Mechanical Manufacturing****WHV: 22h30 (Course: 1h30)****Credits: 2****Coefficient: 1****Prerequisites:** Basic technology, materials science,**Objectives:**

To provide the student with knowledge of manufacturing techniques for products, particularly mechanical products.

Content of the material:**Chapter 1: Metal Cutting Theory (6 weeks)****Chapter 2: Machine Tool Technologies (9 weeks)****Assessment method:**

Final exam: 100%

Bibliographical references:

1- Techniques de l'ingénieur 2000 B.BM.BT. Janvier 2000 Printed in France by Imprimerie Strasbourgeoise Schiltigheim- ISTRAIN

2- Roger Bonetto les ateliers flexibles de production 2ème édition Hermes 1987-Paris

3- G. Levallant ; M.Dessoly ; P.Géodossi ; P.Leroux ; J.C.Moulet ; G.Poulachon ; P.Robert Usinage par enlèvement de copeaux- de la technologie aux applications industrielles Ensam. Edition Eyrolles N° 7211- Juin 2005 Paris

4- Eléments de Fabrication Edition Ellipses. Copyright 1995 Paris

5- Michel Ahby, Choix de Matériaux en Conception Mécanique ; Dunod, 1999

6- Claude Hazard, La Commande Numérique des M O, édition Foucher, Paris 1984

7- Gonzalez, CN par calculateur, édition Foucher Paris 1985.

8- Philippe DEPEYRE, Cours « Fabrication mécanique », Faculté des Sciences et Technologies, Université de la Réunion, Année 2004-2005

Fundamental Unit**Code: FUT 2.2.2****Subjects: Complex Analysis****WHV: 45h00 (Course: 1h30, TUT: 1h30)****Credits: 4****Coefficient:2****Prerequisites:** Mathematics 1, Mathematics 2 and Mathematics 3.**Objectives:**

This course focuses on the differential and integral calculus of complex functions of a complex variable. Students must master the various techniques for solving functions and integrals of complex and special variables.

Content of the material:**Functions of Complex Variables and Special Functions****Chapter 1:** Holomorphic Functions. Cauchy-Riemann Conditions **(3 weeks)****Chapter 2:** Power Series **(3 weeks)****Chapter 3:** Cauchy Theory **(3 weeks)****Chapter 4:** Applications **(4 weeks)****Chapter 5:** Special Functions **(2 weeks)****Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

- 1- Henri Catan, Théorie élémentaire des fonctions analytiques d'une ou plusieurs variables complexes. Editeur Hermann, Paris 1985.
- 2- Jean Kuntzmann, Variable complexe. Hermann, Paris, 1967. Manuel de premier cycle.
- 3- Herbert Robbins Richard Courant. What is Mathematics ?, Oxford University Press, Toronto, 1978. Ouvrage classique de vulgarisation.
- 4- Walter Rudin, Analyse réelle et complexe. Masson, Paris, 1975. Manuel de deuxième cycle.

Fundamental Unit**Code: FUT 2.2.2****Subjects: Strength of Materials 1****WHV: 45h00 (Course: 1h30, TUT: 1h30)****Credits: 4****Coefficient: 2****Prerequisites:** Analysis of functions; rational mechanics.**Objectives:**

To know the methods of calculating the resistance of structural elements and to determine the variations in the shape and dimensions (deformations) of the elements under the action of loads.

Content of the material:**Chapter 1:** Introduction and General Information (2 weeks)**Chapter 2:** Tension and Compression (3 weeks)**Chapter 3:** Shear (2 weeks)**Chapter 4:** Geometric Characteristics of Straight Sections (3 weeks)**Chapter 5:** Torsion (2 weeks)**Chapter 6:** Simple Plane Bending (3 weeks)**Assessment method:**

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

- Mécanique à l'usage des ingénieurs – statique. Ferdinand P. Beer et Russell Johnston, Jr., McGraw-Hill, 1981.
- Résistance des matériaux, P. STEPINE, Editions MIR ; Moscou, 1986.
- Résistance des matériaux 1, William A. Nash, McGraw-Hill, 1974.
- Résistance des matériaux, S. Timoshenko, Dunod, 1986

Fundamental Unit**Code: FUT 2.2.2****Subjects: Industrial Electricity****WHV: 22h30 (Course: 1h30)****Credits:2****Coefficient: 1**

Prerequisites: The fundamental teachings of physical sciences acquired in the common core curriculum of science and technology.

Objectives:

The objective of the program is to provide Mechanical Engineering students with a set of essential knowledge necessary for the physical understanding of the main electrotechnical phenomena.

Content of the material:**Chapter 1: Electrical Circuits (4 weeks)****Chapter 2: Magnetic Circuits (3 weeks)****Chapter 3: Transformers (2 weeks)****Chapter 4: Electrical Machines (3 weeks)****Chapter 5: Electrical Measurements (3 weeks)****Assessment method:**

Final exam: 100%

Bibliographical references:

- Exercices et problèmes d'électrotechniques notions de base, réseaux et machines électriques ; Luc Lasne ; édition Dunod 2011.
- Electrotechnique : modélisation et simulation des machines électriques ; Rachid Abdessemed ; édition Ellipse 2011.
- Circuits électriques : régime continu, sinusoïdal et impulsionnel, Jean-Paul Bancarel , édition Ellipse 2001.
- Analyse des circuits électriques, Charle K. Alexander et Matthew Sadiku ; édition de boeck. 2012.

Methodological Unit**Code: MUT 2.2****Subjects: Numerical Methods****WHV: 67h30 (Course: 1h30, TUT: 1h30 ; PW:1h30)****Credits: 5****Coefficient: 3****Prerequisites:** Math 1, Math 2, Computer Science 1 and Computer Science 2.**Objectives:**

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

Content of the material:**Chapter 1:** Solving Nonlinear Equations $f(x)=0$ (3 weeks)**Chapter 2:** Polynomial Interpolation (2 weeks)**Chapter 3:** Function Approximation (2 weeks)**Chapter 4:** Numerical Integration (2 weeks)**Chapter 5:** Solving Ordinary Differential Equations (2 weeks)**Chapter 6:** Direct Method for Solving Systems of Linear Equations (2 weeks)**Chapter 7:** Approximate Method for Solving Systems of Linear Equations (2 weeks)**Bibliographical references:**

1. Algorithmique et calcul numérique : travaux pratiques résolus et programmation avec les logiciels Scilab et Python / José Ouin, . - Paris : Ellipses, 2013 . - 189 p.
2. Mathématiques avec Scilab : guide de calcul programmation représentations graphiques ; conforme au nouveau programme MPSI / Bouchaib Radi, ; Abdelkhalak El Hami . - Paris : Ellipses, 2015 . - 180 p.

Méthodes numériques appliquées : pour le scientifique et l'ingénieur / Jean-Philippe Grivet, . - Paris : EDP sciences, 2009 . - 371 p

PW Numerical Methods**Prerequisites:** Numerical method, Computer Science 2 and Computer Science 3.**Objectives:**

Programming of different numerical methods for their applications in the field of mathematical calculations using a scientific programming language (matlab, scilab...).

Content of the material:

1. Solving Nonlinear Equations
2. Interpolation and Approximation
3. Numerical Integration

- 4. Differential Equations
- 5. Systems of Linear Equations

Assessment method:

Continuous assessment: 40%, Final exam: 60%

Bibliographical references:

1. BREZINSKI (C.), Introduction à la pratique du calcul numérique. Dunod, Paris (1988).
2. G. Allaire et S.M. Kaber, 2002. Algèbre linéaire numérique. Ellipses.
3. G. Allaire et S.M. Kaber, 2002. Introduction à Scilab. Exercices pratiques corrigés d'algèbre linéaire. Ellipses.
4. G. Christol, A. Cot et C.-M. Marle, 1996. Calcul différentiel. Ellipses.
5. M. Crouzeix et A.-L. Mignot, 1983. Analyse numérique des équations différentielles. Masson.
6. S. Delabrière et M. Postel, 2004. Méthodes d'approximation. Équations différentielles. Applications Scilab. Ellipses.
7. J.-P. Demailly, 1996. Analyse numérique et équations différentielles. Presses Universitaires de Grenoble, 1996.
8. E. Hairer, S. P. Norsett et G. Wanner, 1993. Solving Ordinary Differential Equations, Springer.
9. CIARLET (P.G.). Introduction à l'analyse numérique matricielle et à l'optimisation. Masson, Paris (1982).

Methodological Unit**Code: MUT 2.2****Subjects: Computer-Aided Design****WHV: 22h30 (PW: 1h30)****Credits: 2****Coefficient: 1****Prerequisites:** Technical Drawing.**Objectives:**

This course will enable students to acquire the principles of representing parts in technical drawing. Furthermore, this subject will allow students to represent and read blueprints.

Content of the material:

1. Introduction to the chosen software (SolidWorks, AutoCAD, CATIA, Inventor, etc.) **(4 weeks)**
2. Introduction to sketching **(3 weeks)**
3. 3D modeling **(3 weeks)**
4. Creating drawings for the 3D model **(3 weeks)**
5. Assembly **(2 weeks)**

Assessment method:

Continuous assessment: 100%

Bibliographical references:

- Solidworks bible 2013 Matt Lombard, Edition Wiley,
- Dessin technique, Saint-Laurent, GIESECKE, Frederick E. Éditions du renouveau pédagogique Inc., 1982.
- Exercices de dessins de pièces et d'assemblages mécaniques avec le logiciel SolidWorks, Jean-Louis Berthéol, François Mendes,
- La CAO accessible à tous avec SolidWorks : de la création à la réalisation tome1 Pascal Rétif,
- Guide du dessinateur industriel, Chevalier A, Edition Hachette Technique,

Methodological Unit**Code: MUT 2.2****Subjects: PW: Strength of Materials****WHV: 22h30 (PW: 1h30)****Credits: 1****Coefficient: 1****Prerequisites:** Strength of materials, materials science.**Objectives:**

to put into practice the different stresses studied in the materials strength module and determination of material characteristics from simple mechanical tests.

Content of the material:**Lab 1:** Tensile and simple compression tests**Lab 2:** Torsional test**Lab 3:** Simple bending test**Lab 4:** Impact strength test**Lab 5:** Hardness test**Assessment method:**

Continuous assessment: 100%

Code: MUT 2.2

Subjects: PW: Mechanical Manufacturing

WHV: 22h30 (PW: 1h30)

Credits: 1

Coefficient: 1

Prerequisites: Courses in mechanical manufacturing and technical drawing.

Objectives:

to implement the different machining processes.

Content of the material:

PW 1: Turning a cylindrical part with two diameters, including facing and turning operations.

PW 2: Milling and drilling a prismatic part, primarily involving milling and drilling.

PW 3: Surface grinding and examination of surface finish (using the part from PW 2).

PW 4: Welding

Assessment method:

Continuous assessment: 100%

Discovery unit

Code: DUT 2.2
Subjects: Materials Science
WHV: 22h30 (Course: 1h30)
Credits: 1
Coefficient: 1

Prerequisites: The core subjects of S1 and S2.

Objectives:

This subject allows the student to learn about the classification of materials as well as the basic concepts of crystallography; equilibrium diagrams and heat treatments.

Content of the material:

Chapter 1: Generalities (3 weeks)

Chapter 2: Equilibrium Diagrams (4 weeks)

Chapter 3: Iron-Carbon Equilibrium Diagram (4 weeks)

Chapter 4: Heat Treatments and Thermochemical Diffusion Treatment (3 weeks)

Assessment method:

Final exam: 100%

Bibliographical references:

- Science et génie des matériaux ; De William D. Callister.Dunod.
- Matériaux. T1 Propriétés, applications et conception, Michael F. Ashby, David R. H. Jones Collection: Sciences Sup, Dunod
- Matériaux. T2 Microstructures, mise en œuvre et conception ; Michael F. Ashby, David R. H. Jones Collection: Sciences Sup, Dunod
- Des matériaux, Jean-Marie Dorlot, Jean-Paul Bailon. Presses internationales Polytechnique.
- Structures et matériaux : L'explication mécanique des formes, James Gordon

Transversal unit

Code: TUT 2.2

Subjects: Information and Communication Technologies

WHV:22h30 (Course: 1h30)

Credits:1

Coefficient:1

Prerequisites: Languages (Arabic; French; English)

Objectives:

This course aims to develop students' skills, both personal and professional, in the field of communication and expression techniques. It also enables students to learn about the techniques, tools, and methods used to facilitate communication.

Content of the material:

Chapter 1: Researching, Analyzing, and Organizing Information **(2 weeks)**

Chapter 2: Improving Expression Skills **(2 weeks)**

Chapter 3: Developing Autonomy, Organizational Skills, and Communication Skills within a Project-Based Approach **(2 weeks)**

Chapter 4: ICT - Definition and Evolution **(2 weeks)**

Chapter 5: Researching, Using, and Retrieving Information **(2 weeks)**

Chapter 6: ICT Rights **(2 weeks)**

Chapter 7: Securing Sensitive Information, Protecting Confidential Data, and Preventing Harmful Information **(3 weeks)**

Assessment method:

Final exam: 100%

Bibliographical references:

1. Jean-Denis Commeignes, 12 méthodes de communications écrites et orale – 4^{ème} édition, Michelle Fayet et Dunod 2013.
2. Denis Baril, Sirey, Techniques de l'expression écrite et orale, 2008.
3. 3- Matthieu Dubost, Améliorer son expression écrite et orale toutes les clés, Edition Ellipses 2014.
4. Allegrezza Serge et Dubrocard Anne (edited by). Internet Econometrics. Palgrave Macmillan Ltd, 2011. ISBN-10: 0230362923 ; ISBN-13: 9780230362925
5. Anduiza Eva, Jensen J. Michael et JorbaLaja (edited by). Digital Media and Political Engagement Worldwide. Cambridge UniversityPress - M.U.A, 2012. ISBN-10: 1107668492 ; ISBN-13: 9781107668492
6. Baron G.L., et Bruillard E. L'informatique et ses usagers dans l'éducation. Paris, PUF, 1996. ISBN-10: 2130474926; ISBN-13: 978-2130474920
7. En ligne Chantepie P. et Le Diberder A. Révolution numérique et industries culturelles. Repères. Paris, La Découverte, 2010. ISBN-10: 2707165050; ISBN-13: 978-2707165053
8. Dawn Medlin B. Integrations of Technology Utilization and Social Dynamics in Organizations. Information Science Reference (Isr), 2012. ISBN-10: 1-4666-1948-1; ISBN-13: 978-1-4666-1948-7
9. Devauchelle B. Comment le numérique transforme les lieux de savoirs. FYP Editions, 2012. ISBN-10: 2916571612; ISBN-13: 978-2916571614

10. Greenfield David. « The Addictive Properties of Internet Usage ». In Internet Addiction, 133?153. John Wiley & Sons, Inc., 2007. ISBN: 9780470551165. <http://dx.doi.org/10.1002/9781118013991.ch8>.
11. Kurihara Yutaka et [Al.]. Information technology and economic development. Information Science Reference (Isr), 2007. ISBN 10: 1599045818 ; ISBN 13: 9781599045818
12. Paquelin D. L'appropriation des dispositifs numériques de formation. Du prescrit aux usages. Paris, L'Harmattan, 2009. ISBN-10: 2296085563 ; ISBN-13: 978-2296085565
13. Tansey Stephen D. Business, information technology and society. Routledge Ltd, 2002. ISBN-10: 0415192137 ; ISBN-13: 978-0415192132

Semester 5

Teaching unit	Subjects	Credits	Coefficient	Weekly hourly volume			Semestrial Hourly Volume (15 Weeks)	Additional Work in Consultation (15 Weeks)	Evaluation method	
	Title			Course	TuT	PW			Continuous Control	Exam
Fundamental unit Code: FUT 3.1.1 Credits: 10 Coefficients: 5	Analytical mechanics	6	3	3h00	1h30		67h30	82h30	40%	60%
	Mechanical Construction1	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental Unit Code: FUT 3.1.2 Credits: 8 Coefficients: 4	Material resistance 2	4	2	1h30	1h30		45h00	55h00	40%	60%
	Elasticity	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological Unit Code : MUT 3.1 Credits : 9 Coefficients : 5	Industrial Drawing	4	2			2h30	37h30	42h30	100%	
	Computer-Assisted Design and Manufacturing	4	2			3h00	45h00	55h00	100%	
	PW Metrology	1	1			1h30	22h30	22h30	100%	
Discovery unit Code : DUT 3.1 Credits : 2 Coefficients : 2	Servo Control and Regulation	1	1	1h30			22h30	02h30		100%
	Industrial Maintenance	1	1	1h30			22h30	02h30		100%
Transversal unit Code :TUT 3.1 Credits : 1 Coefficients : 1	Environment and sustainable development	1	1	1h30			22h30	02h30		100%
Total semester 5		30	17	12h00	6h00	7h00	375h00	375h00		

Detailed program by subject

Semester: 5

Teaching Unit: UEF 3.1.1

Subject: Analytical Mechanics

Total Hours (VHS): 67 hours (course: 3h00, TUT: 1h30)

Credits: 6

Coefficient: 3

Learning Objectives

This course provides students with the necessary tools to analyze mechanical problems, to choose the most appropriate solution method based on the nature of the problem, its data, and its unknowns. The course is divided into two parts: the first part focuses on solid dynamics using classical mechanics, while the second part deals with analytical mechanics through the application of energy principles in solving mechanical problems.

Recommended Prerequisites

Rational Mechanics, Physics 1, Mathematics

Course Content

Part A: Supplementary Concepts in Solid Mechanics

Chapter 1: Dynamics of Solid Bodies

(3 weeks)

Translation Motion, Rotation about a Fixed Axis, Planar Motion. Motion of a Rigid Body about a Fixed Point in Space, Euler's Equation, Euler Angles, Motion of a Rigid Body in Space. Central Force Motion.

Chapter 2: Elements of Kinetics

(1 weeks)

Inertia Tensor. Kinetic Energy

Part B: Analytical Mechanics

Chapter 3: Fundamental Concepts

(2 weeks)

Mechanical Constraints and Their Classifications, Mechanical Systems and Their Classifications, Constraint Equation, Possible and Virtual Displacements, Degrees of Freedom, Work of Constraint Forces, Generalized Coordinates and Velocities, Coordinate Transformation Equations.

Chapter 4: Principle of Virtual Work

(1 week)

Chapter 5: D'Alembert's Principle

(1 week)

Chapter 6: Lagrange's Equations of the First Kind

(1 week)

Chapter 7: Lagrange's Equations of the Second Kind

(3 weeks)

Chapter 8: Hamilton's Equations

(3 weeks)

Hamiltonian Formalism, Hamilton's Equation, Routh's Equation.

Assessment Method: Continuous Assessment: 40%; Final Exam: 60%.

Bibliographic References:

- a. S. Targ, *Éléments De Mécanique Rationnelle*, éditions Mir, Moscou.
- b. J. Starjinski, *Mécanique rationnelle*, édition Mir, Moscou.
- c. V. I. Arnold, *Les méthodes mathématiques de la mécanique classique*, Editions Mir, Moscou.

- d. H. Cabannes, *Problèmes de mécanique générale*, Dunod.
- e. M. Combarous, D. Desjardin & C. Bacon, *Mécanique des solides et des systèmes : Cours et exercices corrigés*, Dunod.
- f. W. B. Kibble & F. H. Berkshire, *Classical Mechanics*, 5th Edition, Imperial College Press.
- g. G. Kotkine & V. Serbo, *Recueil de problèmes de mécanique classique- réponses et solutions*, éditions Mir, Moscou.
- h. Jozef HERING, *Cours de mécanique, Mécanique analytique*, OPU, Alger, 1993.

Semester: 5
Course Unit: UEF 3.1.1
Subject: Mechanical Construction 1
Total Hours (VHS): 45h00 (course: 1h30, TUT: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:

To provide students with scientific and technological training in the field of mechanical design by introducing them to standard machine elements and components used in the construction of mechanical structures, mechanisms, and machines. The course also covers their standardization and the mechanical transmission of power.

Recommended Prerequisites

Industrial Drawing, Strength of Materials SOM., Mechanical Manufacturing Processes.

Course Content:

Chapter 1: Introduction (2 weeks)

General Overview (Mechanical Design, Study of Design, Safety Factor, Standards, Economy, Reliability).

Chapter 2: Threaded Assemblies (3 weeks)

Screws, Bolts, Studs, Strength Calculation (Shear, Bearing, Bending, Tightening of a Hyperstatic System).

Chapter 3: Non-Detachable Assemblies (4 weeks)

Riveting (Different Types of Rivets and Riveting, Dimensioning Calculation, etc.)
 Welding (Different Types of Welds, Welding Calculations: Butt, Edge, Fillet, Cylindrical, Dynamic Load, etc.).

Chapter 4: Assembly of Parts by Force Fit (3 weeks)

Introduction, Advantages, Disadvantages, Strength Calculation (Axial Load, Torsional Moment).

Assembly by Hub Heating, Assembly by Shaft Cooling, Fit Calculation.

Chapter 5: Obstacle Elements (3 weeks)

Keys, Splines, and Springs (Dimensioning and Strength Calculation).

Assessment Method: Continuous Assessment: 40%; Final Exam: 60%.

Bibliographic References:

2. Buchet Jean David Morvan. *Les engrenages* Ed. : Delcourt G. Productions 01/2004
3. Georges Henriot. *Les engrenages* Ed. : Dunod
4. Alain Pouget , Thierry Berthomieu , Yves Boutron, Emmanuel Cuenot. *Structures et mécanismes - Activités de construction mécanique* Ed. Hachette Technique
5. R. Quatremer, J-P Trotignon, M. Dejans, H. Lehu. *Précis de Construction Mécanique, Tome 1, Projets-études, composants, normalisation*, AFNOR, NATHAN 2001.
6. R. Quatremer, J-P Trotignon, M. Dejans, H. Lehu. *Précis de Construction Mécanique, Tome 3, Projets-calculs, dimensionnement, normalisation*, AFNOR, NATHAN 1997.
7. YoudeXiong, Y. Qian, Z. Xiong, D. Picard. *Formulaire de mécanique, Pièces de construction*, EYROLLES, 2007.
8. Jean-Louis FANCHON. *Guide de Mécanique*, NATHAN, 2008.
9. Francis ESNAULT. *Construction mécanique, Transmission de puissance, Tome 1, Principes et Ecoconception*, DUNOD, 2009.

10. Francis ESNAULT. *Construction mécanique, Transmission de puissance, Tome 2, Applications*, DUNOD, 2001.
11. Francis ESNAULT, DUNOD. *Construction mécanique, Transmission de puissance, Tome 3, Transmission de puissance par liens flexibles*, 1999.
12. Bawin, V. et Delforge, C., *Construction mécanique*, Edition originale : G. Thome, Liège, 1986.
13. M. Szwarcman. *Eléments de machines*, édition Lavoisier 1983
14. W. L. Cleghorn. *Mechanics of machines*, Oxford University Press, 2008.

Semester: 5

Teaching Unit: UEM 3.1.2

Subject: Strength of Materials 2

Total Hours (VHS): 45 hours (course: 1h30, Tutorials: 1h30)

Credits: 4

Coefficient: 2

Course Objectives:

This course is a continuation of the Strength of Materials taught in the fourth semester. It will cover combined stresses, energy methods, and hyperstatic systems.

Recommended Prerequisites:

Strength of Materials 1, Materials Science, Mathematics

Course Content:

- | | |
|---|------------------|
| Chapter 1: Planar Bending of Symmetric Beams – Review | (2 weeks) |
| <ul style="list-style-type: none"> • Review of Bending Moment – Shear Force. • Normal Stresses in Simple Bending • Shear Stresses in Simple Bending | |
| Chapter 2: Displacement of Symmetric Beams in Planar Bending | (2 weeks) |
| <ul style="list-style-type: none"> • Displacement of Beams with Constant Cross-Section • Initial Parameters Method • Moment-Area Method • Superposition Method | |
| Chapter 3: General Theorems of Elastic Systems (Applications) | (3 weeks) |
| <ul style="list-style-type: none"> • Elastic Strain Energy in Tension • Elastic Strain Energy in Torsion • Elastic Strain Energy in Shear • Elastic Strain Energy in Bending • General Expression for Elastic Strain Energy • Castigliano's Theorem • Generalized Virtual Force Method | |
| Chapter 4: Combined Stresses | (3 weeks) |
| <ul style="list-style-type: none"> • Generality • Curved Bending (Generalities, Stresses, Deformations) • Combined Bending • Bending-Torsion | |
| Chapter 5: Solution of Hyperstatic Systems | (4 weeks) |
| <ul style="list-style-type: none"> • General Overview (Bar Systems, Nodes, Joints, Frames, Portal Frames, etc.) • Initial Parameters Method • Superposition Method for Force Effects • Three-Moment Equations Method • Force Method | |

Chapter 6: Design Examples – Applications**(1 week)****Assessment Method:** Continuous Assessment: 40%; Final Exam: 60%.**Bibliographic References:**

1. A. Giet ; L. Geminard. *Résistance des matériaux*, Editions Dunod 1986, Paris.
2. S. P. Timoshenko. *Résistance des matériaux*, Editions Dunod ; Paris.
3. M. Albiges, ; A Coin .*Résistance des matériaux*, Editions Eyrolles 1986 ; Paris.
4. Jean-Claude Doubrère. *Résistance des matériaux*, Editions Eyrolles 2013
5. YoudeXiong. *Exercices résolus de résistance des matériaux*, Editions Eyrolles, 2014.
6. Claude Chèze. *Résistance des matériaux - Dimensionnement des structures, Sollicitations simples et composées, flambage, énergie interne, systèmes hyperstatiques*, Ellipses, 2012.

Semester: 5
Course Unit: UEF 3.1.2
Subject: Elasticity
Total Hours (VHS): 45h00 (course: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:

This course introduces the fundamental concepts of elasticity, focusing on stress and strain tensors as well as Hooke's laws.

Recommended Prerequisites:

- Algebra
- Differential and Integral Calculus
- Matrix Calculations
- Strength of Materials

Course Content:

Chapter 1: Introduction, Mathematical Review (3 weeks)

Index Notation, Vector Calculus, Tensor Calculus.

Chapter 2: Stress Tensor (4 weeks)

- Sectioning, Surface Element, and Stress Vector
- Cauchy's Formula, Stress Tensor
- Equilibrium Equations
- Principal Stresses and Principal Directions
- Scalar Invariants of the Stress Tensor
- Spherical Tensor and Deviator

Chapter 3: Strain Tensors (3 weeks)

- Displacement Vector
- Strain Tensor
- Length and Angle Transformations
- Principal Strains
- Scalar Invariants of the Strain Tensor
- Spherical Tensor and Deviator

Chapter 4: Hooke's Laws (Stress-Strain Relationships) (4 weeks)

- Stress-Based Formulation
- Strain-Based Formulation
- Thermoelastic Formulation

Chapter 5: Strength Criteria (1 week)

- Maximum Normal Stress Criterion (Rankine Criterion)
- Maximum Shear Stress Criterion (Tresca Criterion)
- Von Mises Criterion

Assessment Method: Continuous Assessment: 40%; Final Exam: 60%.

Bibliographic References:

1. Harry Lass , Vector and Tensor Analysis, McGraw-Hill, 1950
2. A. I. Borisenko and I. E. Tarapov, Vector and Tensor Analysis, Dover, 1979
3. Frank Ayres, Matrices Cours et Problèmes, Schaum,1983
4. Martin H. Sadd. Elasticity : Theory, applications and Numerics, Elsevier 2005.
5. Yves Debard. Elasticité, Université Lemans, 2006.
6. Guenfoud M., Introduction à la mécanique des milieux continus application à la mécanique des solides, Université de 8 mai 1945 Guelma, 2006.
7. Gabriel Lamé. Leçons sur la théorie mathématique de l'élasticité des corps solides, Editions Jacques Gabay, Paris 2006.
8. Denis Dartus. Elasticitélinéaire, Editions Cépaduès, paris 1995.
9. Jean Coirier. Mécanique des milieux continus, Cours et exercicescorrigés, Dunod, 2013.

Semester: 5
Teaching Unit: UEM 3.1
Subject: Technical Drawing (Industrial Drawing)
Total Hours (VHS): 45 hours (Practical Work PW: 3h00)
Credits: 4
Coefficient: 2

Course Objectives:

This course complements the technical drawing course from Semester 4. It enables students to acquire the principles of standardized representation of mechanical parts, known as industrial drawing. Furthermore, it allows students to create and interpret drawings of mechanisms and machines. The course also aims to enhance the student's graphical imagination to master this universal language of communication among technicians, and ultimately prepares them for effective use of DAO-CAO tools.

Recommended Prerequisites:

Technical Drawing, General Technology, and Conventional Mechanical Manufacturing Processes.

Course Content:

Chapter 1: Basic Mechanical Functions (3 weeks)

Mechanical joints (elementary joint, joint characteristics, joint methods, joint implementation). Centering and orientation functions (rotational guidance, translational guidance, functional dimensioning, fits, technical specifications and symbols).

Chapter 2: Drawing Interpretation (3 weeks)

Sketches, dimensions, kinematic diagrams, assembly drawings, detail drawings, exploded views.

Chapter 3: Drawing Analysis (5 weeks)

Assembly of bearings, thrust bearings, joints, plain bearings, stops, gears, lubrication function, sealing, dimension chains.

Chapter 4: Application – CAD of a Mechanical System (4 weeks)

Modeling of various parts
 Assembly including the use of standard part libraries (bearings, screws, etc.)
 Drawing layout (tolerances, functional clearances, fits, etc.)

Note :

- Chapters 1 and 2 constitute the mechanical technology section and should be presented as lectures accompanied by application examples.
- The student's personal work for this subject should be assigned in the form of a mini-project.:
 - Creation of the assembly drawing of a mechanism and the detailed drawings of its individual components, including fit calculations and application of functional dimensioning.

- Use of DAO to draw a set of parts, perform the assembly, and finally present the technical drawing with all relevant details (dimensioning, technological symbols, etc.).

Assessment Method: Final Exam: 100%..

Bibliographic References:

1. Chevalier A. *Guide du dessinateur industriel*, Editions Hachette Technique,
2. Saint-Laurent, GIESECKE, Frederick E. *Dessin technique*, Éditions du renouveau pédagogique Inc., 1982.
3. Jean-Louis Berthéol, François Mendes. *Exercices de dessins de pièces et d'assemblages mécaniques avec le logiciel SolidWorks*, Edition Castilla 2007
4. Lenormand, Foucher. *Mémento de dessin industriel T1: Convention de présentation cotation*, Edition Dunod
5. Heurtematte J. *Aide mémoire de dessin de l'élève dessinateur et du dessinateur industriel*, Delagrave.
6. Norbert M. *Aide-mémoire de l'élève dessinateur*, Casteilla.
7. , J-Louis Franch. *Guide des sciences et technologies industrielle*,. DUNOD
8. Michel Denis. *Le dessin assisté par ordinateur*. Editions Hermes 2008
9. Sites internet du *modeleur volumique SolidWorks* (forum – tutoriaux – exemples)

Semester: 5
Teaching Unit: UEM 3.1
Subject: Computer-Aided Design and Manufacturing (CFAO)
Total Hours (VHS): 45 hours (Practical Work PW: 3h00)
Credits: 4
Coefficient: 2

Course Objectives:

This course allows students to become familiar with the use of FAO software on one hand, and to be introduced to Computer-Aided Manufacturing (FAO) and gain familiarity with CNC machine tools on the other hand.

Recommended Prerequisites:

Technical Drawing, Mechanical Manufacturing, D.A.O.

Course Content:

CAO Part

- Introduction and use of CAD software. **(1 week)**
- Techniques for reconstructing curved surfaces - Bézier curves, poles, NURBS - B-splines: basic functions, properties. **(2 weeks)**
- Complex surfaces, concepts of curvature, connectivity, junctions. **(2 weeks)**
- CAD tools for shape design - Design of a parameterized 2D system - An example of polyhedral modeling. **(2 weeks)**
- Design of stamped shapes, mold impressions. **(2 weeks)**

FAO Part

- Introduction to CNC machines (various components and parts). Positioning parts on the machines. Selection of cutting tools and definition of their geometries. Setting the part origin. **(2 weeks)**
- Machining a part by turning and analysis of the program generated by the software. **(2 weeks)**
- Machining a part by milling and analysis of the program generated by the software. **(2 weeks).**

Assessment Method: Continuous Assessment: 100%

Bibliographical References:

1. A. Cornand, F. Kolb & J. Lacombe. *Usinage et commande numérique, T2*, 1992,
2. G. Faidherbe & B. Vacossin, Cetim. *L'Environnement des centres d'usinage*, Senlis, 1991,
3. B. Froment & J.-J. Lesage. *Productique. Les techniques de l'usinage flexible*, Dunod, Paris, 1988
4. P. Gonzalez. *La Commande numérique par ordinateur : tournage, fraisage, centres d'usinage*, Casteilla, Paris, 1993
5. C. Hazard. *La Commande numérique des machines-outils*, Foucher, 1984
6. *Machines-outils : calculs, bases fondamentales, éléments de construction*, Vander, Bruxelles, 1969
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9. A. Cornand, F. Kolb & J. Lacombe, *Usinage et commande numérique*, t. II, Foucher, Paris, 1992
10. Centre international technique d'enseignement et de formation, *La Commande d'axe*, C.I.T.E.F., Rueil-Malmaison, 1991

11. G. Faidherbe & B. Vacossin, *L'Environnement des centres d'usinage*, Cetim, Senlis, 1991
12. P. Gonzalez, *La Commande numérique par ordinateur : tournage, fraisage, centres d'usinage*, Casteilla, Paris, 1993
13. R. Kibbe, J. Neely, R. Meyer et al., *Machine Tool Practices*, Prentice-Hall, New York, 1991
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15. J. W. Oswald & S. F. Krar, *Technology of Machine Tools*, McGraw-Hill, New York, 4e éd. 1989
16. J. Vergnas, *Usinage : technologie et pratique*, Dunod, Paris, 2e éd. 1989
17. A. Chevalier- J..Bohan- A.Molina ; *Guide pratique de la productique*
18. C.Barlier – B-Poulet ; *Memotech –Génie mécanique- Productique Mécanique*
19. A.Chevalier et J. Bohan ; *Guide du technicien en fabrication mécanique*

Semester: 5

Teaching Unit: UEM 3.1

Subject: Laboratory on Metrology

Total Hours (VHS): 15 hours (PW: 1h00)

Credits: 1

Coefficient: 1

Objectives of the Course:

The metrology PW will allow students to become familiar with and handle various measurement techniques. They will learn about measuring instruments with direct and indirect readings used in mechanics.

Recommended Prerequisite Knowledge:

Metrology Course, Applied Mathematics, Technical Drawing, Mechanical Manufacturing, D.A.O.

Course Content:

PW1 (in two parts): Calibration of measuring and control devices for lengths (Vernier caliper, micrometer, dial indicator, and depth gauge). Concepts of calibration, errors, and measurement uncertainty.

PW 2: Checking inclinations, angles, and cones.

PW 3: Checking threads and gears.

PW 4: Checking geometric form tolerances: circularity, cylindricity, straightness, flatness, parallelism, eccentricity, etc.

PW 5: Checking surface roughness and surface condition.

PW6: Use of special control devices.

Assessment Method: Continuous Assessment: 100%

Bibliographical References:

1. Jean Claude HOCQUET, *métrologie*, EncyclopædiaUniversalis, :<http://www.universalis.fr/encyclopedie/metrologie/>
2. Ammar Grous. *Métrologie appliquée aux sciences et technologies - Volume 1* Hermès - Lavoisier 2009

Semester: 5
Teaching Unit: UED 3.1
Subject: Control and Regulation
Total Hours (VHS): 22h30 (course: 1h30)
Credits: 1
Coefficient: 1

Teaching Objectives:

To recognize the main control techniques for mechanical systems and the components involved.

Recommended Prerequisites:

Mathematics, Numerical Methods

Course Content:

Chapter 1: Terminology of Control Systems (1 week)

Functional diagram of a feedback control system. Components of a functional diagram in a feedback system.

Chapter 2: Laplace Transform (2 weeks)

Definitions and properties.

Chapter 3: Transfer Functions (2 weeks)

Block diagram algebra and system transfer functions.

Chapter 4: Study of First-Order Control Systems (3 weeks)

Definition and transfer function. System response to various input signals.

Chapter 5: Study of Second-Order Control Systems (3 weeks)

Definition and transfer function. System response to various input signals. Representation of the system in the complex plane.

Chapter 6: BODE and Nyquist Diagrams of Control Systems (2 weeks)

Chapter 7: Stability Analysis of Control Systems (2 weeks)

Analytical stability criteria according to Routh and Hurwitz. Geometric stability criterion according to Nyquist.

Assessment Method: Exam: 100%.

Bibliographic References

- 1- Henri Bourles. *Systèmes linéaires de la modélisation à la commande*. Editions Lavoisier 2006, Paris.
- 2- Jean Marie Flans .*La régulation industrielle*; Hermès 1994 ; Paris.
- 3- Philippe de Larminat. *Automatique commande des systèmes linéaires*. Editions Hermès 1996 ; Paris
- 4- Patrick Prouvost. *Automatique – Contrôle et régulation*, EditionDunod 2010.

- 5- Yves GRANJON. *Automatique* . Edition Dunod 2010
- 6- Olivier Le Gallo. *Automatique des systèmes mécaniques*. Edition Dunod , 2009
- 7- Gérard Boujat, Patrick Anaya. *Automatique industrielle*, 2007. Edition Dunod
- 8- JANET Maurice. *Précis de calcul matriciel et de calcul opérationnel*, Edition Euclide 1982
- 9- Patrick Prouvost. *Automatique – Contrôle et régulation*. Edition Dunod 2010.

Semester: 5
Teaching Unit: UED 3.1
Subject: Maintenance
Total Hours (VHS): 22h30 (course: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:

Through this subject, the student will gain an understanding of the role of maintenance within a company, its organization, as well as its various functions. The student will also be able to perform calculations related to reliability.

Recommended Prerequisites:

Course Content:

- | | |
|---|------------------|
| Chapter 1: General Maintenance Overview | (2 weeks) |
| <ul style="list-style-type: none"> • Importance of maintenance in a company • Objectives of maintenance in a company • Maintenance policies in a company | |
| Chapter 2: Different Forms of Maintenance | (4 weeks) |
| <ul style="list-style-type: none"> • Types of maintenance actions • Maintenance operations • Levels of maintenance • Related activities of maintenance | |
| Chapter 3: Maintenance Organization | (4 weeks) |
| <ul style="list-style-type: none"> • Preparation of maintenance work • Maintenance work planning • Human resource management • Studies and methods office | |
| Chapter 4: Equipment Tracking and Logistics | (2 weeks) |
| <ul style="list-style-type: none"> • Knowledge and behavior of equipment • Logistic function | |
| Chapter 5: Maintenance Reliability | (3 weeks) |
| <ul style="list-style-type: none"> • Maintenance and reliability • Reliability indicators • Reliability calculation • Failure mode analysis and causes (FMEA) | |

Assessment Method: Exam: 100%.

Bibliographic References

- 1- GODELIER E. *La culture d'entreprise*, Éditeur : La Découverte - 30/08/2006
- 2- Boitel D., Hazard C. *Guide de la maintenance*, Edition Elisabeth Ponard Avril 1990.
- 3- Auberville J. M. *Maintenance industrielle – de l'entretien de base à l'optimisation de la sureté* Edition Ellipses – Juin 2004.
- 4- Zwingelstein G. *La maintenance basée sur la fiabilité* Edition HERMES, 1996.
- 5- Vernier J. P. *Fonction maintenance* A 8300 Techniques de l'ingénieur.
- 6- Bleux J. M., Fanchon J. L. *Maintenance : Systèmes automatisés de production*, Edition Nathan Janvier 2000.
- 7- FD X60- 000 *Maintenance industrielle : Fonction maintenance*, Normalisation française. Mai 2002.
- 8- Ridoux M. *AMDEC-Moyen*. Techniques de l'Ingénieur, traité L'entreprise industrielle. AG 4 220.

Semester: 5
Course Unit: UET 3.1
Subject: Environment and Sustainable Development
VHS: 22h30 (course: 1h30)
Credits: 1
Coefficient: 1

Course objectives:

To raise students' awareness of the relationship between energy, the environment, and sustainable development, and to master the sources of pollution; to reduce them in order to ensure sustainable development.

Recommended prior knowledge:

Fluid mechanics, fundamental thermodynamics, heat transfer, and environmental characteristics.

Content of the course:

Chapter 1: Introduction to the Concept of Environment (2 Weeks)

Definition of the environment, general definition, legal definition, brief history, man and the environment, how humans have altered their environment, demography as a scapegoat.

Chapter 2: The Concept of Sustainable Development (2 Weeks)

Definition, brief history, the fundamental principles of sustainable development, the ethical principle, the precautionary principle, the prevention principle, the objectives of sustainable development, environmental challenges of sustainable development.

Chapter 3: Environment and Natural Resources (4 Weeks)

Introduction, resources, water, air, fossil fuels (oil, natural gas, coal,...), other energies (solar, wind, hydro, geothermal, biomass,...), mineral elements, biodiversity, soils, food resources.

Chapter 4: Substances (4 Weeks)

Different types of pollutants, regulated pollutants, organic compounds, heavy metals, particles, chlorofluorocarbons, effects of various substances on the environment, greenhouse effect and climate change, ozone layer destruction, acidification, eutrophication, and photochemistry, acid rains, ozone peaks; effects on materials; effects on ecosystems: forests, freshwater reserves, health effects. Different types of emitters, Corinair classification.

Chapter 5: Environmental Preservation (3 Weeks)

Introduction of new materials, reserving oil for noble uses, improving energy efficiency, recycling, economic, legal, and regulatory mechanisms for environmental preservation, the role of public authorities in solving environmental issues, the feasible option of private solutions, current environmental policies, the polluter-pays principle, ecological taxation: eco-taxes, the market for tradable emission permits.

Assessment Method: Exam: 100%.

Bibliographic References

- 1- De Jouvenel, B., « Le thème de l'environnement, Analyse et prévision », 10, pp. 517533, 1970.
- 2- Fauchaux S., Noël J-F, « Economie des ressources naturelles et de l'environnement », Armand Collin, Paris.

- 3- Reed D. (Ed.), « Ajustement structurel, environnement et développement durable », l'Harmattan, Paris, 1995.
- 4- Vivien F.-D., « Histoire d'un mot, histoire d'une idée : le développement durable à l'épreuve du temps », Ed. scientifiques et médicales Elsevier ASA, pp. 19-60, 2001.
- 5- Boutaud, Aurélien, Gondran, Natasha, « L'empreinte écologique », Paris : La Découverte, 2009.
- 6- Lazzeri, Yvette (Dir.), « préface de Gérard Guillaumin, Développement durable, entreprises et territoires: vers un renouveau des pratiques et des outils », Paris, L'Harmattan, 2008.

Semester 6

Teaching unit	Subjects	Credits	Coefficient	Weekly hourly volume			Semestrial Hourly Volume (15 WeeKs)	Additional Work in Consultation (15 WeeKs)	Evaluation method	
	Title			Course	TUT	PW			Continuous Control	Exam
Fundamental unit Code: FUT 3.2.1 Credits: 10 Coefficients: 5	Mechanical Construction 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Theory of mechanisms	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental Unit Code: FUT 3.2.2 Credits: 8 Coefficients: 4	Thermal transfer	4	2	1h30	1h30		45h00	55h00	40%	60%
	Dynamics of structures	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological Unit Code : MUT 3.2 Credits : 9 Coefficients : 5	End of cycle project	4	2			3h00	45h00	55h00	100%	
	Internal combustion engine	4	2	1h30	1h30		45h00	55h00	40%	60%
	PW Thermal transfer	1	1			1h00	15h00	10h00	100%	
Discovery unit Code : DUT 3.2 Credits : 2 Coefficients : 2	Hydraulic and pneumatic systems	1	1	1h30			22h30	02h30		100%
	Non-metallic materials	1	1	1h30			22h30	02h30		100%
Transversal unit Code : TUT 3.2 Credits : 1 Coefficients : 1	Entrepreneurship and business management	1	1	1h30			22h30	02h30		100%
Total semester 6		30	17	13h30	7h30	4h00	375h00	375h00		

Detailed program by subject

Semester: 6
Course Unit: UEF 3.2.1
Subject: Mechanical Construction 2
VHS: 67h00 (course: 3h00, TUT: 1h30)
Credits: 6
Coefficient: 3

Course Objectives:

This subject is a continuation of Mechanical Construction 1 (CM1). It mainly focuses on the dimensioning calculations for key motion transmission components in machines (gears, bearings, shafts, etc.). It also covers the general technological study of mechanisms such as reducers, gearboxes, clutches, brakes, etc.

Recommended Prerequisite Knowledge:

Rational mechanics, Industrial drawing, Strength of materials (RDM), and Mechanical Construction 1 (CM1).

Course Content:

Chapter 1: Gears (Study of Geometric Characteristics of Gear Cutting) (3 weeks)

- Cylindrical gears (straight and helical teeth)
- Conical gears (straight and helical teeth)
- Worm gears

Chapter 2: Introduction to the Dynamic Study of Gears (2 weeks)

- Surface pressure and breaking strength for cylindrical gears (straight and helical teeth)

Chapter 3: Shafts and Axes (3 weeks)

- Preliminary diameter calculation for shafts and axes
- Fatigue verification of shafts and axes

Chapter 4: Motion Transmission (Calculation and Dimensioning) (3 weeks)

- Bearings and bearing supports
- Belts and chains...

Chapter 5: Reducers and Gearboxes (2 weeks)

- Kinematic study of a speed reducer
- Kinematic study of a gearbox
- Concepts of epicyclic trains

Chapter 6: General Concepts of Couplings, Clutches, and Brakes (2 weeks)

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

Bibliographic References

1. Les engrenages (Buchet Jean David Morvan) Ed. :Delcourt G. Productions 01/2004
2. Les engrenages (Georges Henriot) Ed. : Dunod
3. Construction mécanique. Transmission de puissance – volume 3-(F.Esnault) Ed. Dunod

4. Alain Pouget , Thierry Berthomieu , Yves Boutron, Emmanuel Cuenot. *Structures et mécanismes - Activités de construction mécanique*. Ed. Hachette Technique
5. R. Quatremer, J-P Trotignon, M. Dejans, H. Lehu. *Précis de Construction Mécanique, Tome 1, Projets-études, composants, normalisation* , AFNOR, NATHAN 2001.
6. R. Quatremer, J-P Trotignon, M. Dejans, H. Lehu. *Précis de Construction Mécanique, Tome 3, Projets-calculs, dimensionnement, normalisation* , AFNOR, NATHAN 1997.
7. YoudeXiong, Y. Qian, Z. Xiong, D. *Formulaire de mécanique, Pièces de construction*., Picard, EYROLLES, 2007.
8. Jean-Louis FANCHON. *Guide de Mécanique* , NATHAN, 2008.
9. Francis ESNAULT. *Construction mécanique, Transmission de puissance, Tome 1, Principes et Ecoconception*, DUNOD, 2009.
10. Francis ESNAULT. *Construction mécanique, Transmission de puissance, Tome 2, Applications*., DUNOD, 2001.
11. Francis ESNAULT. *Construction mécanique, Transmission de puissance, Tome 3, Transmission de puissance par liens flexibles*., DUNOD, 1999.
12. W. L. Cleghorn. *Mechanics of machines*, , Oxford University Press, 2008.
13. A. CHEVALIER, *Guide du dessinateur industriel*, Edition HACHETTE technique, 1980.
14. Aublinmichel et al., "systèmes mécaniques : *Théorie et dimensionnement*", Ed. Dunod, 1998
15. Drouin g. Et al., "*Eléments de machines*", Ed. Ecole polytechnique de montréal, 1986
16. J. E. Shigley, c. R. Mischke, "*Standard handbook of machine design*", Ed. Mc-graw-hill.
17. Richard g. Budynas, j. Keith nisbett, "shigley's mechanical engineering design", ed. Mc-graw-hill.
18. R. C. Juvinall, k. M. Marshek, "*Fundamentals of machines component design*", ed. JohnWiley & Sons.

Semester: 6
Course Unit: UEF 3.2.1
Subject: Theory of Mechanisms
VHS: 45 hours (course: 1h30, TUT: 1h30)
Credits: 4
Coefficient: 2

Objectives of the Course:

The content of this course will enable students to undertake an analysis or synthesis study of mechanical systems. At the undergraduate level, three essential parts must be considered: (i) a mathematical review covering the necessary mathematical tools for the study of mechanisms (torque, vector product, co-moment, linear systems, etc.); (ii) a thorough understanding of reading mechanical system plans in order to identify equivalence classes, contact graphs, standardized mechanical connections, minimal schematization, and classification of mechanisms; (iii) static and kinematic studies of parallel connections, series connections, and closed chains; (iv) an introduction to the study of cam-based motion transformation mechanisms, such as plotting the real and theoretical profiles of a cam and its follower diagram, etc.

Recommended Prerequisites:

Vector analysis, Industrial drawing, General technology, Mechanical fabrication, and Rational mechanics.

Algebra: Matrices, determinants, linear systems, and matrix operations.

Course Content:

Chapter 1: Preliminary and Reminders

(3 weeks)

- Notion of the wrench and its characteristics
- Definitions and assumptions:

Machine, Mechanisms, Kinematic chain, Fixed element or frame, Kinematic coupling, Planar mechanisms, Spherical mechanisms, Spatial mechanisms, Example of mechanisms.

- Common mechanical couplings:

Chapter 2: Modeling of Mechanisms

(2 weeks)

- Graph associated with a mechanical system
- Chains and kinematic diagrams of a mechanical system

Chapter 3: Mobility and Hyperstaticity of a Mechanism

(4 weeks)

- Definitions: Kinematic and static analysis of parallel couplings
- Kinematic and static analysis of series couplings
- Kinematic and static analysis of closed chains
- Systematic search for isostatic solutions

Chapter 4: Kinematic Analysis of Planar Mechanisms

(3 weeks)

- Definition of a planar mechanism
- Identification of parameters of a planar mechanism
- Grashoff's laws for 4-bar articulated mechanisms
- Analysis of the displacement of a planar mechanism (Graphical method, Analytical method, Case study)

Chapter 5: Introduction to CAD and Mechanism Synthesis (2 weeks)

- Design of an isostatic mechanism using CAD software (SolidWorks)
- Modeling and simulation of a mechanism using CAD-CAE software (e.g., SolidWorks)
- Simulation using the CosmosMotion module

Chapter 6: Generalities on Cam Mechanisms (1 week)

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

Bibliographic References

1. Marc Rossetto et Pierre Agati. Liaison, Mécanismes et Assemblage. 2^{ème} édition,. Collection science Sup. Dunod 2001.
2. Michel Aublin, René Boncompain. Systèmes Mécaniques. Théorie et dimensionnement,. Collection science Sup. Dunod 2005.
3. Marc Rossetto et Pierre Agati. Liaisons et Mécanismes. Dunod 1994
4. Partick Beynet. Sciences industrielle pour l'ingénieur. Ellipse édition Marketing S.A., 2012.
5. Vigen Arakelian. Structure et cinématiques des mécanismes, Hermes 1997
6. Artobolovsky I. I. Théorie des mécanismes et des machine Edition Sciences Moscou 1988
7. R. le Borzec et J. Lotterie. Principe de la théorie des Mécanismes, édition DUNOD 1977
8. BOUDET- C. BORTOLUSSI. Présentation des mécanismes Techniques de l'ingénieur- B 600/8600,1 – R. 1980
9. Jean-Louis Fanchon. Guide des sciences et technologies industrielles. Edition DUNOD 2014.
10. HUNT K.H. Kinematic geometry of mechanisms. Edt Clordon Press oxford 1978
11. A. Caignot et al. Sciences industrielles de l'ingénieur MPSI.PCSI.PTSI, édition Vuibert,
12. A. Caignot et al. Sciences industrielles de l'ingénieur MP/MP*. PSI/PSI*.PT/PT*, édition Vuibert,
13. Jean-Dominique Mosser et al. Sciences industrielles de l'ingénieur Tout-En-Un, édition DUNOD,
14. Mécanique, Deuxieme partie (43e leçon. – Cames et 44e leçon. - Excentriques. Bielles à coulisse. Pédales et balanciers) RENE BASQUIN Edition Delagrave 1990
15. Formulaire de mécanique: Transmission de puissance Eyrrols 2006 Youde Xiong
16. تكنولوجيا الرسم الهندسي (الفصل 8: تصميم الكامات) ، فيرث و قاندر و بليجين الناشر ماكراوهيل

Semester: 6

Course Unit: UEF 3.2.2

Subject: Heat Transfer

VHS: 45 hours (courses: 1h30, TUT: 1h30)

Credits: 4

Coefficient: 2

Course Objectives:

Evaluate the conducted, convected, or radiated fluxes in different situations. Be able to model a thermal problem and solve it in steady-state conditions and simple geometries. Be capable of making the right material choice for any thermal application.

Recommended Prerequisites:

Thermodynamics and mathematics from L1 and L2.

Course Content:

Chapter 1. Heat Conduction

(5 weeks)

- Introduction to heat transfer and its relation to thermodynamics.
- Basic laws of heat transfer.
- Fourier's Law.
- Thermal conductivity and the order of magnitude for common materials. Discussion of the parameters affecting thermal conductivity.
- The energy equation, simplifying assumptions, and its various forms. Spatial and initial boundary conditions. The four linear boundary conditions and their practical significance. Under what conditions can they be implemented?
- Some solutions to the heat equation in Cartesian, cylindrical, and spherical coordinates with boundary conditions and in steady-state conditions.
- Steady-state conduction with heat sources.
- Electrical analogy: Series and parallel resistances (composite materials and concentric cylinders).
- Fins: Types of fins, practical importance of fins. Equation of the longitudinal rectangular fin. Solutions for the four classical boundary conditions. Calculation of lost heat, efficiency, and effectiveness of the fin. Optimal thickness of longitudinal rectangular fins.

Chapter 2. Heat Transfer by Convection

(4 weeks)

- Mechanisms of heat transfer by convection. Parameters involved in convective heat transfer.
- Identification of different types of convective transfer: Forced, natural, and mixed convection. Common examples. Differentiating between laminar and turbulent convective transfer in both forced and natural modes.
- Methods for solving a convection problem (Dimensional analysis and experiments, integral methods for boundary layer equations, solving equations representing convection and analogy with similar phenomena like mass transfer).
- Dimensional analysis with experiments: Pi Theorem, identifying the most commonly used dimensionless numbers in convection (Reynolds, Prandtl, Grashoff, Rayleigh, Peclet, and Nusselt numbers) for forced and natural convection. Explaining the significance of these numbers and the use of the most common correlations through concrete examples.

Chapter 3. Heat Transfer by Radiation**(5 weeks)**

- Introduction: Concepts of solid angles.
- Mechanism of radiative heat transfer by surface and volume.
- Definitions and general laws (Luminance, illuminance, intensity, emittance...).
- Bouguer's formula, Kirchhoff's law, and Draper's law.
- The black body (BB). Planck's Law. Flux emitted by the BB in a spectral band. Stefan-Boltzmann Law.
- Global radiative properties of gray surfaces and their interrelations.
- Radiative exchange between two parallel, infinitely extended planes separated by a transparent medium. Concepts of shielding.
- Radiative exchange between two concave black surfaces. Concepts of view factors. Reciprocity relations. Summation rule. Superposition rule. Symmetry rule. View factors between infinitely long surfaces. The method of crossed strings.
- Lost flux by a concave surface.
- Radiative exchange between n arbitrary surfaces forming an enclosure. Enclosure rules for view factors. The irradiation-radiance method for evaluating exchanged fluxes.
- Electrical analogy in radiative heat transfer.

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

Bibliographic References

1. Jean-Luc Battaglia, Andrzej Kusiak, Jean-Rodolphe Puiggali, *Introduction aux transferts thermiques, cours et solutions*, Dunod éditeur, Paris 2010.
2. J. F. Sacadura coordonnateur, *Transfert thermiques : Initiation et approfondissement*, Lavoisier 2015.
3. A-M. Bianchi , Y. Fautrelle , J. Etay, *Transferts thermiques*, Presses Polytechniques et Universitaires Romandes 2004
4. Kreith, F.; Boehm, R.F.; et. al., *Heat and Mass Transfer, Mechanical Engineering Handbook* Ed. Frank Kreith, CRC Press LLC, 1999.
5. Bejan and A. Kraus, *Heat Handbook Handbook*, J. Wiley and sons 2003.
6. Y. A. Cengel, *Heat transfer, a practical approach*, Mc Graw Hill, 2002
7. Y. A. Cengel, *Heat and Mass Transfer*, Mc Graw Hill
8. H. D. Baehr and K. Stephan, *Heat and Mass transfer*, 2nd revised edition, Springer Verlag editor, 2006.
9. F. P. Incropera and D. P. Dewitt, *Fundamentals of Heat and Mass transfer*, 6th edition, Wiley editor.
10. J. P. Holman, *Heat Transfer*, 6th edition, Mc Graw Hill editor, 1986.
11. J. H. Lienhard IV and J. H. Lienhard V, *Heat Transfer Textbook*, 3rd edition, Phlogiston Press, 2004
12. Chris Long and Naser Sayma, *Heat Transfer*, Ventus Publishing APS, 2009
13. Hans Dieter Baehr, Karl Stephan, *Heat and Mass Transfer*, Springer editor, 2006

Semester: 6
Teaching Unit: UEF 3.2.2
Subject: Structural Dynamics
VHS: 45 hours (course: 1h30, tutorials: 1h30)
Credits: 4
Coefficient: 2

Objectives of the course:

Mastering the methods for studying the displacements and stresses imparted to a given structure subjected to an arbitrary dynamic load.

Recommended Prerequisites:

(RDM1), Solving Differential Equations.

Course Content:

Chapter 1: Introduction to Structural Dynamics

(2 weeks)

- Objective of structural dynamics
- Characteristics of a dynamic problem
- Types of loading
- Simple harmonic motion
- Vector representation of harmonic motion

Chapter 2: Forced Vibrations of Single-Degree-of-Freedom Systems

(3 weeks)

- Structure (Harmonic excitation, Periodic excitation, Arbitrary dynamic excitation)
- Response of a conservative structure
- Response of a damped structure

Chapter 3: Vibrations with Two Degrees of Freedom

(3 weeks)

- Free vibrations (Concept of natural modes)
- Time response of an excited system

Chapter 4: Systems with N Degrees of Freedom

(4 weeks)

- Matrix properties
- Frequency and mode calculations
- Response to excitation

Chapter 5: Vibration Measurement

(2 weeks)

- Basic schematic
- Seismography
- Accelerometry
- Calibration

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

Bibliographic References

- 1- R. Clough, J. Penzien, *Dynamique des structures* Pluralis (1980)
- 2- M. Lalanne, P. Berthier, J.D.Hagopian, *Mécanique des vibrations linéaires* Masson (1980)
- 3- S.G.Kelly, *Mechanical Vibrations. Theory and applications*. Cengage learning (2012)
- 4- Thomas Gmür *Dynamique des Structures - Analyse Modale Numérique*, Presses Polytechniques et Universitaires Romandes, 1997
- 5- Patrick Paultre. *Dynamique des structures*, Hermès - Lavoisier, 2005,
- 6- Samikian A. *Analyse et calcul des structures*, Québec, 1984,
- 7- Studer M.A. et Frey F. *Introduction à l'analyse des structures*, Lausanne, 1997,
- 8- Clough R. et Penzien J. A. *Dynamics of Structures*, deuxième édition, C. Berkeley, 2004,

Semester: 6
Teaching Unit: UEM 3.2
Subject: Final Year Project
Total Hours (VHS): 45h00 (PW: 3h00)
Credits: 4
Coefficient: 2

Objectives of the course:

To assimilate, in a comprehensive and complementary way, the knowledge acquired from various subjects. To practically apply the concepts taught during the training. To foster students' autonomy and sense of initiative. To teach them to work in a collaborative environment while stimulating their intellectual curiosity.

Recommended Prerequisites:

All program of Licence.

Course Content:

The topic of the Final Year Project must result from a joint decision between the supervising instructor and a student (or a group of students: pairs or trios). The subject matter must necessarily align with the training objectives and the actual skills of the student (Bachelor's level). Furthermore, it is preferable for the topic to take into account the social and economic context of the institution. When the nature of the project requires it, it may be divided into several parts.

Note:

During the weeks in which students are familiarizing themselves with the purpose and feasibility of their project (literature review, research on necessary software or hardware, revision and consolidation of relevant coursework, etc.), the course supervisor should use the face-to-face time to review key content from the two subjects "*Writing Methodology*" and "*Presentation Methodology*" covered during the first two semesters of the core curriculum.

At the end of this study, the student must submit a written report that clearly presents:

- A detailed presentation of the chosen topic, emphasizing its relevance in the socio-economic context.
- The resources used: methodological tools, bibliographic references, professional contacts, etc.
- The analysis of the results obtained and their comparison with the initial objectives.
- A critique of any discrepancies observed and, if applicable, presentation of additional details.
- Identification of difficulties encountered, highlighting the limitations of the work performed and possible follow-up.

The student or student group will then present their work (in the form of a brief oral presentation or poster) before their supervising instructor and an examining instructor, who may ask questions and assess the work in terms of both technical content and presentation quality.

Assessment method: Continuous assessment: 100%

Bibliographic References

Semester: 6
Course Unit: UEM 3.2
Subject: Internal Combustion Engine
Total Hours (VHS): 45h00 (course: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course Objectives:

To understand the operation of different types of internal combustion engines, both from a thermodynamic and a mechanical perspective.

Recommended Prerequisites:

Physics, Thermodynamics

Course Content:

Chapter 1: General Overview (3 weeks)

- Operating principle and classification of thermal engines
- Fuels used in internal combustion engines

Chapter 2: Thermodynamics of Engine Cycles (4 weeks)

- The Beau de Rochas cycle
- The Diesel cycle
- The Sabathé cycle
- Real cycles and efficiencies
- Energy balance
- Fuel supply system for gasoline engines
- Ignition system for gasoline engines
- Combustion

Chapter 3: Real Cycle of a Diesel-Type Internal Combustion Engine (3 weeks)

Intake; Compression; Combustion; Expansion; Exhaust; Indicated parameters; Effective parameters; Construction of the theoretical indicator diagram.

Chapter 4: Dynamics of Reciprocating Engines (3 weeks)

- Crank-connecting rod mechanism: Kinematic study – Dynamic study
- Valve train system: Kinematic study – Dynamic study
- Balancing

Chapter 5: Performance and Characteristics of Reciprocating Engines (2 weeks)

Performance parameters, Standards, Characteristics: Full load – Partial load – Universal

Note: It is essential to schedule a few practical lab sessions on internal combustion engines, depending on the available resources of the institution.

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

Bibliographic References

1. J. B. Heywood, *Internal Combustion Fundamentals*, McGraw Hill Higher Education 1989
2. P. Arquès, *Conception et construction des moteurs alternatifs*, Ellipse 2000
3. J-C. Guibet, *Carburants et moteurs*, 1997
4. P. Arquès, *Moteurs alternatifs à combustion interne (Technologie)*, Masson édition 1987.
5. -FAMIN U.Y., GORBAN A.I., DOBROVOLSKY V.V, LUKIN A.I. et al. *Moteurs marins à combustion interne*. Leningrad:Sudostrojenij, 1989, 344p.
6. Menardon M. *Le moteur à explosion*, Paris, Deboeck ,98
7. Jolivet D. *Le moteur diesel*, Paris Ellipses ,86
8. Benabbassi A. *Les moteurs à combustion interne*, Introduction à la théorie, Alger, OPU. 2002.

Semester: 6
Teaching Unit: UEM 3.2
Subject: Heat Transfer Lab
Total Hours: 15h00 (PW: 01h00)
Credits: 1
Coefficient: 1

Course Objectives:

Consolidate knowledge in conduction and convection.

Recommended Prerequisites:

Physics, Thermodynamics

Course Content:

Plan a few experiments related to heat transfer according to available resources.

Assessment Method: Continuous assessment: 100%

Bibliographic References

Semester: 6
Course Unit: UED 3.2
Subject: Hydraulic and Pneumatic Systems
Total Hours (VHS): 22h30 (Course: 01h30)
Credits: 1
Coefficient: 1

Course Objectives:

The objective of the program is to provide students with a set of essential and necessary knowledge for the physical understanding of the main components of hydraulic and pneumatic systems.

Recommended Prerequisites:

Knowledge of fluid mechanics and thermodynamics.

Course Content:

Chapter 1: Introduction and Background (2 weeks)

Hydraulic fluids: different types of hydraulic fluids — mineral oil, synthetic oil, and water-based products; characteristics of hydraulic fluids. Viscosity: influence of temperature and pressure on viscosity. Flow regimes, Reynolds number, head losses. Filtration. Quality of intake air: humidity, contamination by solid particles, various types of air filters.

Chapter 2: Pumps and Compressors (4 weeks)

Positive displacement pumps and compressors: classification; axial piston pumps, radial piston pumps, vane pumps, gear pumps, screw pumps. Hydraulic and pneumatic motors: general concepts, motor classification — axial piston motors, radial piston motors, gear motors, vane motors, low-speed cam and roller motors.

Chapter 3: Actuators (Cylinders) (2 weeks)

Cylinders: classification; single-acting return cylinders, single-acting cylinders, basic double-acting cylinders, differential double-acting cylinders, double-rod double-acting cylinders, telescopic cylinders, rotary actuators. Stiffness of a cylinder: stiffness expression and calculation example. End-of-stroke cushioning, rod buckling.

Chapter 4: Hydraulic Lines (3 weeks)

Piping: rigid lines (materials and dimensions), flexible lines. Pressure regulation: direct-operated and pilot-operated pressure relief valves, pressure reducers. Flow control: flow limiters, flow regulators, check valves. Directional control valves, accumulators, and applications. Study of hydraulic and pneumatic systems.

Chapter 5: Practical Examples (3 weeks)

- Control of a pneumatic motor
- Control of a bidirectional hydraulic motor
- Speed control of a cylinder
- Design of a hydraulic circuit

Chapter 6: Simulation Software (1 week)

Simulation software for hydraulic and pneumatic systems (e.g., Automation Studio - Hydraulics, etc.)

Assessment Method: Exam: 100%

Bibliographic References

1. J. Faisandier :*Mécanismes hydrauliques et électro-hydrauliques*. Ed. Dunod 2006
2. Fawcett. *Applied hydraulics and pneumatics in industry*. Trade and Technical Press Ltd , 2009.
3. Gille,DecaulnePelegrin. *Théorie et technique des asservissements* ,Dunod
4. J. Faisandier*Mécanismes hydrauliques et pneumatiques*, Collection: Technique et Ingénierie, Dunod/L'Usine Nouvelle. 2013 - 9ème édition
5. José Roldanveloria. *Aide-mémoire d'hydraulique industrielle*. Dunod 2004
6. www.thierry-lequeu.fr/data/99ART147.HTM

Semester: 6
Course Unit: UED 3.2
Subject: Non-Metallic Materials
Total Hours (VHS): 22h30 (course: 01h30)
Credits: 1
Coefficient: 1

Course Objectives:

To introduce students to the science of non-metallic materials by providing them with knowledge specific to these materials. The focus will be particularly on polymer materials, ceramics, and composite materials.

Recommended Prerequisites:

Basic science knowledge acquired during the common core curriculum.

Course Content:

Chapter 1: Overview of Plastics (2 weeks)

Structures and properties, processing techniques, standardization.

Chapter 2: Introduction to Polymeric Materials (3 weeks)

- Nature and structure of polymeric materials
- Macromolecular chains, thermoplastic and thermosetting polymers
- Elastomers, amorphous and semi-crystalline polymers
- Properties of polymeric materials: mechanical properties, physical properties, thermomechanical tests, long-term behavior (aging), combustion
- Polymer processing techniques
 - Polymerization by addition or condensation

Chapter 3: Glass and Ceramics (3 weeks)

- Structure of inorganic glasses
- Types of ceramics and application fields
- Manufacturing and microstructure of ceramics
- Glass manufacturing and forming
- Mechanical, electrical, thermal, and optical properties
- Degradation of ceramics

Chapter 4: Composite Materials (4 weeks)

- Material combinations and anisotropy
- Constituents and their properties
- Manufacturing, forming, and properties of different composite families: polymer matrix, metal matrix, ceramic matrix, and foams
- Issues related to assembly and machining
- Mechanical testing
- Specific mechanical behavior of composite materials
- Calculation methods: homogenization, rule of mixtures, constitutive laws, failure criteria

Assessment Method: Exam: 100%

Bibliographic References

1. Wilfried Kurz, Jean P. Mercier. *Introduction à la science des matériaux* 2^{ième} édition.. 1991
2. Marc Carrega et Coll. *Matériaux polymères*. Dunod, 2000
3. Traités des matériaux 14. *Matériaux polymères : propriétés mécaniques et physiques*. Presses polytechnique et universitaire Romandes. 2001
4. Claude Bathias et Coll. *Matériaux composites* 2^{ième} édition . L'usine nouvelle Dunod, 2009

Semester: 6
Course Unit: UET 3.2
Subject: Entrepreneurship and Business Management
Total Hours (VHS): 22h30 (course: 1h30)
Credits: 1
Coefficient: 1

Course Objectives:

- Prepare students for professional integration upon graduation;
- Develop entrepreneurial skills among students;
- Raise awareness and familiarize students with the opportunities, challenges, procedures, characteristics, attitudes, and skills required for entrepreneurship;
- Equip students to eventually create their own business or, at the very least, better understand their role within an SME.

Recommended Prerequisites:

No specific prior knowledge is required, except proficiency in the language of instruction.

Targeted Skills:

Ability to analyze, synthesize, work in teams, communicate effectively both orally and in writing, be autonomous, plan and meet deadlines, and demonstrate responsiveness and proactivity. Develop awareness of entrepreneurship through an overview of management knowledge useful for business creation.

Course Content:

Chapter 1 – Operational Preparation for Employment: (2 weeks)

Writing a cover letter and developing a CV, job interviews, documentary research on careers in the field, conducting interviews with professionals, and job interview simulations.

Chapter 2 – Entrepreneurship and Entrepreneurial Spirit: (2 weeks)

Entrepreneurship, businesses around you, entrepreneurial motivation, setting goals, taking risks.

Chapter 3 – The Entrepreneur’s Profile and the Entrepreneurial Profession: (3 weeks)

Qualities of an entrepreneur, negotiation skills, listening skills, the role of SMEs and very small enterprises (VSEs) in Algeria, key success factors in creating a VSE/SME.

Chapter 4 – Finding a Good Business Idea: (2 weeks)

Creativity and innovation, recognizing and evaluating business opportunities.

Chapter 5 – Launching and Operating a Business: (3 weeks)

Choosing the right market, selecting the business location, legal forms of business, seeking support and financing to start a business, recruiting staff, choosing suppliers.

Chapter 6 – Developing the Business Project:**(3 weeks)**

Business Model and Business Plan, implementing the business project using the Business Model Canvas.

Assessment Method: Exam: 100%

Bibliographic References

- FayolleAlain, 2017. Entrepreneuriat théories et pratiques, applications pour apprendre à entreprendre.Dunod, 3e éd.
- LégerJarniou, Catherine, 2013, Le grand livre de l'entrepreneur. Dunod, 2013.
- PlaneJean-Michel, 2016, Management des organisations théories, concepts, performances. Dunod, 4ème éd.
- LégerJarniou, Catherine, 2017, Construire son Business Plan. Le grand livre de l'entrepreneur. Dunod,.
- Sion Michel, 2016, Réussir son business Méthodes, outils et astuces plan.Dunod ,4èmeéd.
- Patrick Koenblit, Carole Nicolas, Hélène Lehongre, Construire son projet professionnel, ESF, Editeur 2011.
- Lucie Beauchesne, Anne Riberolles, Bâtir son projet professionnel, L'Etudiant 2002.
- ALBAGLI Claude et HENAULT Georges (1996), La création d'entreprise en Afrique, ed EDICEF/AUPELF ,208 p.