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

Université of Médéa

TRAINING OFFER
L.M.D.
ACADEMIC BACHELOR'S DEGREE
NATIONAL PROGRAM
2025 - 2026
(3rd update)

Establishment	Faculty / Institute	Department
University of Médéa	**Technology**	**Process Engineering and Environment**

Domaine	Field	Specialty
Sciences and Technologies	**Process Engineering**	***Process Engineering***

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اللجنة البيداغوجية الوطنية
لميدان العلوم و التكنولوجيا

National Pedagogical Committee of the Science and Technology Domain

عرض تكوين
ل. م . د
ليسانس أكاديمية

برنامج وطني
2025 - 2026

المؤسسة	الكلية/ المعهد	القسم
هندسة الطرائق والبيئة	هندسة	جامعة المدية

الميدان	الفرع	التخصص
علوم و تكنولوجيا	هندسة الطرائق	هندسة الطرائق

– Semester organization charts of teaching for the specialty

Semester 1

Teaching unit	Subjects	Credits	Coefficien	Weekly hours			semester hours (15 weeks)	Complementary Work in Consultation (15 weeks)	Assessment mode	
	Title			Lecture	TD	PW			Continuous assessment	Exam
Fundamental Teaching Unit Code: UEF 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 Teaching Unit Code: UEF 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 Teaching Unit Code: UEM 1.1 Credits: 6 Coefficients: 4	Elements of mechanics Practical Work	2	1			1h30	22h30	22h30	100%	
	Structure of matter Practical Work	2	1			1h30	22h30	22h30	100%	
	Computer structure and applications	2	2	1h30		1h00	37h30	22h30	40%	60%
Transversal Teaching Unit Code: UET 1.1 Credits: 2 Coefficients: 2	Ethical and deontological dimension (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**		

Semester 2

Teaching unit	Subjects	Credits	Coefficient	Weekly hours			semester hours (15 weeks)	Complementary Work in Consultation (15 weeks)	Assessment mode	
	Title			Lecture	TD	PW			Continuous assessment	Exam
Fundamental Teaching Unit Code: UEF 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 Teaching Unit Code: UEF 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 Teaching Unit Code: UEM 1.2 Credits: 6 Coefficients: 4	Electricity and magnetism Practical Work	2	1			1h30	22h30	22h30	100%	
	Thermodynamics Practical Work	2	1			1h30	22h30	22h30	100%	
	Introduction to programming	2	2	1h30		1h00	37h30	22h30	40%	60%
Transversal Teaching Unit Code: UET 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**		

Semester 3

Teaching unit	Subjects	Credits	Coefficient	Weekly hours			semester hours (15 weeks)	Complementary Work in Consultation (15 weeks)	Assessment mode	
	Title			Lecture	TD	PW			Continuous assessment	Exam
Fundamental Teaching Unit Code: UEF 2.1.1 Credits: 10 Coefficients: 5	Waves and vibrations	6	3	1h30	3h00		67h30	82h30	40%	60%
	Fluid mechanics	4	2	1h30	1h30		45h00	45h00	40%	60%
Fundamental Teaching Unit Code: UEF 2.1.2 Credits: 9 Coefficients: 5	Inorganic chemistry	5	3	1h30	1h30	1h30	67h30	82h30	40%	60%
	Probability and statistics	4	2	1h30	1h30		45h00	45h00	40%	60%
Methodological Teaching Unit Code: UEM 2.1 Credits: 10 Coefficients: 6	Python programming	4	2	1h30	1h30		45h00	45h00	40%	60%
	Technical drawing	2	2	1h30		1h30	22h30	27h30	100%	
	Waves and vibrations Practical Work	2	1			1h30	22h30	27h30	100%	

	HSE Industrial installations	2	1			1h00	15h00	17h50	100%	
Discovery Teaching Unit Code: UET 2.1 Credits: 1 Coefficients: 1	Waves and vibrations	1	1	1h30			22h30	02h30		100%
Total semester 3		**30**	**17**	**10h30**	**9h00**	**5h30**	**375h00**	375h00		

Semester 4

Teaching unit	**Subjects**	**Credits**	**Coefficie**	**Weekly hours**			**semester hours (15 weeks)**	**Complementary Work in Consultation (15 weeks)**	**Assessment mode**	
	Title			**Lecture**	**TD**	**PW**			Continuous assessment	Exam
Fundamental Teaching Unit Code: UEF 2.2.1 Credits: 9 Coefficients: 5	Chemistry of solutions	4	2	1h30	1h30		45h00	45h00	40%	60%
	Organic chemistry	5	3	1h30	1h30	1h00	60h00	75h00	40% (20%TD+20%PW)	60%
Fundamental Teaching Unit Code: UEF 2.2.2 Credits: 8 Coefficients: 4	Chemical thermodynamics	4	2	1h30	1h30		45h00	50h00	40%	60%
	Chemical kinetics	4	2	1h30	1h30		45h00	50h00	40%	60%
Methodological Teaching Unit Code: UEM 2.2 Credits: 11	Numerical methods	5	3	1h30	1h30	1h30	67h30	82h30	40% (20%TD+20%PW)	60%
	Instrumentation - sensors	4	2	1h30	1h30		45h00	45h00	40%	60%

Coefficients: 6	Chemistry of solutions and chemical kinetics Practical Work	2	1			1h30	22h30	22h30	100%	
Transversal Teaching Unit Code: UET 2.2 Credits: 2 Coefficients: 2	Information and communication techniques	2	2	1h30	1h30 workshop		45h00	5h00	40%	60%
Total semester 4		**30**	**17**	**10h30**	**9h00**	**5h30**	**375h00**	**375h00**		

Semester 5

Teaching unit	Subjects	Credits	Coefficient	Weekly hours			semester hours (15 weeks)	Complementary Work in Consultation (15 weeks)	Assessment mode	
	Title			Lecture	TD	PW			Continuous assessment	Exam
Fundamental Teaching Unit Code: UEF 3.1.1 Credits: 12 Coefficients: 6	Heat Transfer	4	2	1h30	1h30		45h00	55h00	40%	60%
	Mass Transfer	4	2	1h30	1h30		45h00	55h00	40%	60%
	Momentum Transfer	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental Teaching Unit Code: UEF 3.1.2 Credits: 8 Coefficients: 4	Electrochemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
	Kinetics and homogeneous catalysis	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological Teaching Unit Code: UEM 3.1 Credits: 8 Coefficients: 5	Analysis techniques	3	2	1h30		1h00	37h30	42h30	40%	60%
	Physical Chemistry 1 and Chemical Engineering 1 Practical Work	2	1			1h30	22h30	22h30	100%	
	Macroscopic balances	3	2	1h30	1h30		45h00	30h00	40%	60%
Discovery Teaching Unit Code: UED 3.1 Credits: 2 Coefficients: 2	Pharmaceutical and agri-food processes	1	1	1h30			22h30	02h30		100%
	Air, water and soil pollution	1	1	1h30			22h30	02h30		100%
Total semester 5		**30**	**17**	**13h30**	**9h00**	**2h30**	**375h00**	**375h00**		

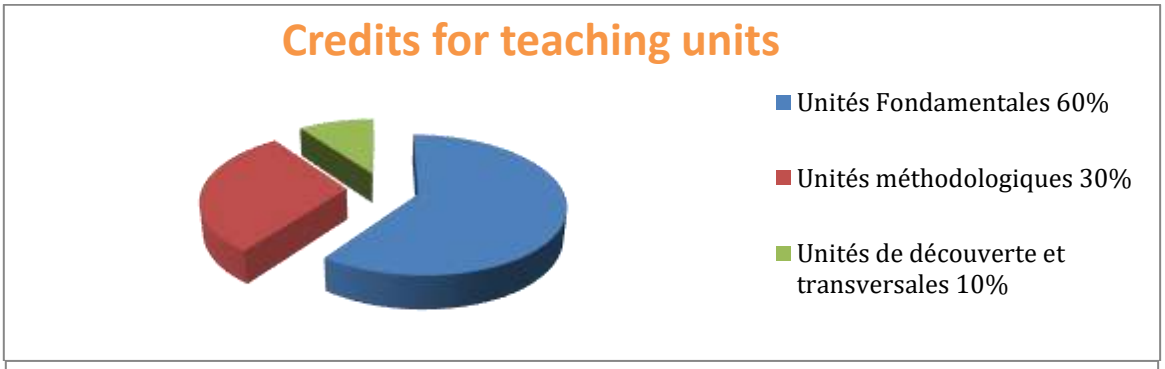
Semester 6

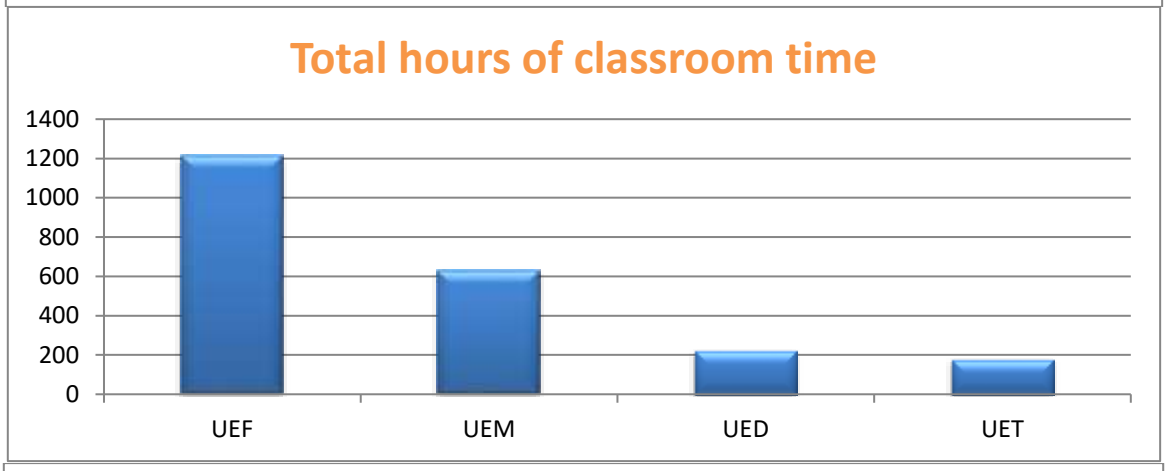
Teaching unit	Subjects	Credits	Coefficient	Weekly hours			semester hours (15 weeks)	Complementary Work in Consultation (15 weeks)	Assessment mode	
	Title			Lecture	TD	PW			Continuous assessment	Exam
Fundamental Teaching Unit Code: UEF 3.2.1 Credits: 10 Coefficients: 5	Unit operations	6	3	3h00	1h30		67h30	82h30	40%	60%
	Thermodynamics of equilibria	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental Teaching Unit Code: UEF 3.2.2 Credits: 8 Coefficients: 4	Homogeneous reactors	4	2	1h30	1h30		45h00	55h00	40%	60%
	Surface phenomena and heterogeneous catalysis	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological Teaching Unit Code: UEM 3.2 Credits: 9 Coefficients: 5	End-of-Cycle Project	4	2			2h30	37h30	42h30	100%	
	Process simulators	3	2	1h30		1h30	37h30	50h00	40%	60%
	Physical chemistry 2 and chemical engineering 2 Practical Work	2	1			1h30	22h30	27h30	100%	
Discovery Teaching Unit Code: UED 3.2 Credits: 2 Coefficients: 2	Cryogenic processes	1	1	1h30			22h30	02h30		100%
	Corrosion	1	1	1h30			22h30	02h30		100%
Transversal Teaching Unit Code: UET 3.2 Credits: 1 Coefficients: 1	Entrepreneurship and start-up	1	1	1h30			22h30	02h30		100%
Total semester 6		**30**	**17**	**13h30**	**6h00**	**5h30**	**375h00**	**375h00**		

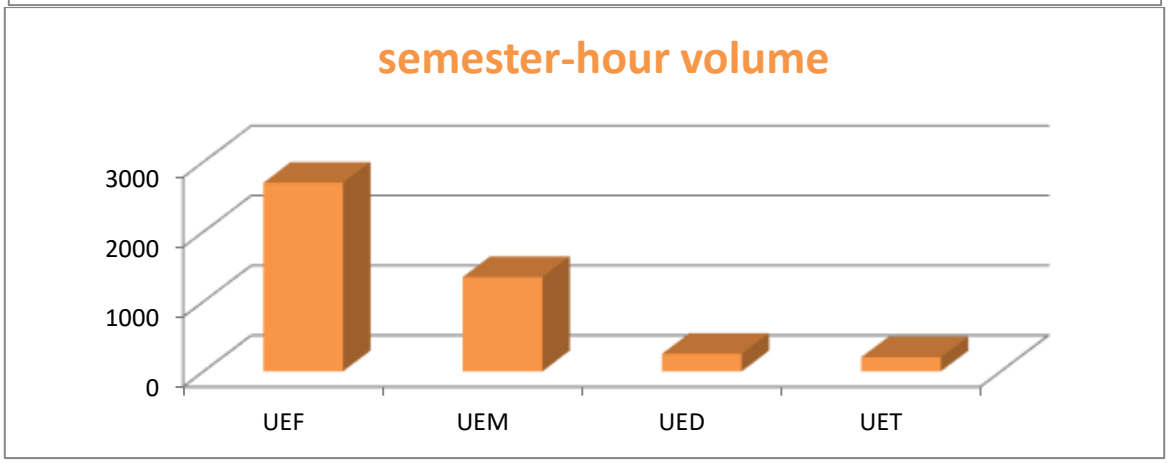
The assessment modes presented in these tables are given for information purposes only; the institution's training team may propose other weightings.

Overall summary of the training:

UE / VH	UEF	UEM	UED	UET	Total
Lecture	742h30	165h00	225h00	180h00	1312h30
TD	472h30	45h00	---	---	517h30
PW	---	420h00	---	---	420h00
Personnel work	1485h00	720h00	25h00	20h00	2250h00
Other ()	---	---	---	---	---
Total	2700h00	1350h00	250h00	200h00	4500h00
Credits	108	54	10	8	180
% of credits four each UE	60 %	30 %	10 %		100 %







III - Detailed program by subject

Semestre: 1

Unité d'enseignement: UEF 1.1
Matière 3: Analyse 1
SH: 67h30 (Cours: 1h30, TD: 3h00)
Crédits: 6
Coefficient: 3

Prerequisites:
Basic mathematics concepts from senior high school (sets, functions, equations, etc.).

Course objectives
This first Analysis I course is primarily devoted to standardizing students' knowledge as they enter university. New concepts are taught gradually in order to prepare students for more advanced mathematics. The concepts covered in this course are fundamental and among the most widely used in science and technology.

Course content:
Chapter 1: Properties of the set R
1. Upper bound, lower bound, and bounded set.
2. Maximum element, minimum element.
3. Upper bound, lower bound.
4. Absolute value, integer part.

Chapter 2: Real number sequences
1. Convergent sequences.
2. Comparison theorems.
3. Monotonic convergence theorem.
4. Extracted sequences.
5. Adjacent sequences.
6. Special sequences (arithmetic, geometric, recursive)

Chapter 3: Real functions with a single variable
1. Limits and continuity of functions
2. Derivative and differential of a function
3. Applications to elementary functions (power, exponential, hyperbolic, trigonometric, and logarithmic)

Chapter 4: Limited expansion
1. Limited expansion
2. Taylor's formula
3. Limited expansion of functions

Chapter 5: Simple integrals
1 Reminders on

Bibliographic references:

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

Semestre: 1

Unité d'enseignement: UEF 1.1
Matière 1: Algèbre 1
SH: 45h00 (Cours: 1h30, TD: 1h30)
Crédits: 4
Coefficient: 2

Prerequisites:
Basic mathematics concepts from senior high school (sets, functions, equations, etc.).

Course objectives
This first Algebra I course is primarily devoted to standardizing students' knowledge as they enter university. New concepts are taught gradually in order to prepare students for more advanced mathematics. The concepts covered in this course are fundamental and among the most widely used in science and technology..

Course content:

Chapter 1. Sets, relations, and applications (5 weeks)
Set theory.
Order relations, equivalence relations.
Injective, surjective, bijective, and inverse functions: definition of a function, direct image, inverse image, characteristics of a function.
Chapter 2: Complex numbers (5 weeks)
Definition of a complex number.
Representation of a complex number: algebraic representation, trigonometric representation, geometric representation, exponential representation.
Roots of a complex number: square roots, solving the equation $az^2+bz+c=0$, nth root of a complex number.

Chapter 3: Vector space (5 weeks)
Vector space, basis, dimension (definitions and basic properties).
Linear application, kernel, image, rank.

Assessment method: Written test, supervised assignment, final exam

Bibliographic 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 – 2e année du 1er cycle classes préparatoires, Vuibert Université.
4. B. Calvo, J. Doyen, A. Calvo, F. Boshet, Exercices d'algèbre, 1er cycle scientifique préparation aux grandes écoles 2e année, Armand Colin – Collection U.

Semester: 1

Teaching unit: UEF 1.2
Subject: Elements of mechanics
SH: 67h30 (Lecture: 1h30, Tutorial: 3h00)
Credits: 6
Coefficient: 3

Prerequisites:
It is recommended that students have a good grasp of basic physics and mathematics from secondary school.

Objectives:
This course enables students to acquire a fundamental understanding of classical mechanics related to material points through:
- kinematics
- dynamics
- and the concepts of work and energy.

Course content:

Chapter I: Review
- Dimensional analysis
- Vector analysis

Chapter II: Kinematics
- Concept of reference frame
- Study of movements in space (general case, circular, rectilinear, intrinsic coordinates)
- Coordinate systems (Cartesian, polar, cylindrical, spherical)
- Relative motion (laws of composition of velocities and accelerations)

Chapter III: Dynamics
- Principle of inertia, inertial mass, and Galilean reference frame
- Momentum – Principle of conservation of momentum
- Concept of force
- Newton's laws
- Differential equation of motion
- Different types of force (gravitational, elastic, viscous, etc.)

Chapter IV: Rotational motion
- Kinetic momentum, moment of a force
- Kinetic momentum theorem and moment of inertia
- Applications: torsion, pendulum, etc.

Chapter V: Work, power, energy
- Work and power of a force
- Kinetic energy
- Potential energy (gravitational, elastic, etc.) and states of equilibrium.
- Conservative and non-conservative forces.
- Conservation of energy.
- Impulse and collisions (elastic and inelastic)

Assessment method:
Written test, supervised assignment, final exam, practical report,

Semester: 1

Teaching unit: UEF 1.2
Subject: Structure of matter
SH: 67h00 (Lecture: 1h30, Tutorial: 3h00)
Credits: 6
Coefficient: 3

Course objectives
This course enables students to acquire basic formalisms in chemistry, particularly in the areas of atoms and chemical bonds, chemical elements, and the periodic table with energy quantification. It also improves students' ability to solve chemistry problems.

Recommended prior knowledge
Basic concepts of mathematics and general chemistry.

Course content:

Chapter 1: Fundamental concepts (2 weeks)
States and macroscopic characteristics of states of matter, changes in states of matter, concepts of atoms, molecules, moles, and Avogadro's number, atomic mass units, atomic and molecular molar mass, molar volume, Law of Conservation of Mass (Lavoisier), chemical reactions, qualitative aspects of matter, quantitative aspects of matter.

Chapter 2: Main constituents of matter (3 weeks)
Introduction: Faraday's experiment: relationship between matter and electricity, Identification of the components of matter and therefore of the atom, and some physical properties (mass and charge), Rutherford's planetary model, Presentation and characteristics of the atom (symbol, atomic number Z, mass number A, number of protons, neutrons, and electrons), Isotopy and relative abundance of different isotopes, Separation of isotopes and determination of the atomic mass and average mass of an atom: Mass spectrometry: Bainbridge spectrograph, Binding and cohesive energy of nuclei, Stability of nuclei.

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

Chapter 4: Electronic structure of the atom (2 weeks)
Wave-particle duality, Interaction between light and matter, Bohr atomic model: hydrogen atom, Hydrogen atom in wave mechanics, Multi-electron atoms in wave mechanics.

Chapter 5: Periodic classification of elements (3 weeks)
D. Mendeleev's periodic table, modern periodic table, evolution and periodicity of the physical and chemical properties of elements, calculation of atomic and ionic radii, successive ionization energies, electron affinity and electronegativity (Mulliken scale) using Slater's rules.

Chapter 6: Chemical bonds (3 weeks)
Covalent bonding in Lewis theory, polarized covalent bonding, dipole moment and partial ionic character of the bond, molecular geometry: Gillespie or VSEPR theory, chemical bonding in the quantum model.

Assessment method:
Continuous assessment: 40%; 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, 3e édition, Dunod, 2003.
4. F. Vassaux, La chimie en IUT et BTS.
5. A. Casalot & A. Durupthy, Chimie inorganique cours 2ème cycle, Hachette.
6. P. Arnaud, Cours de Chimie Physique, Ed. Dunod.
7. M. Guymont, Structure de la matière, Belin Coll., 2003.
8. G. Devore, Chimie générale : T1, étude des structures, Coll. Vuibert, 1980.
9. M. Karapetiantz, Constitution de la matière, Ed. Mir, 1980.

Semester: 1

Teaching unit: UEM 1.1
Subject: Elements of Mechanics Practical Work
SH: 22H30 (Practical Work: 3h00)
Credits: 2
Coefficient: 1

Prerequisites:
It is recommended that students have a good grasp of basic physics and mathematics from secondary school.

Objectives:
This course teaches students the fundamental concepts of classical mechanics related to material points through:
- kinematics
- dynamics
- and the concepts of work and energy.

Practical work in physics 1:

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

Assessment method:
Written test, supervised assignment, final exam, practical work report.

Semester: 1
Teaching unit: UEM 1.1
Subject: Practical work Structure of matter
Lectures: 22.5 hours (Tutorials: 1.5 hours)
Credits: 2Coefficient: 1

Teaching objectives
This course enables students to acquire basic formalisms in chemistry, particularly in the subject describing atoms and chemical bonds, chemical elements, and the periodic table with energy quantification. It aims to improve students' ability to solve chemistry problems.

Recommended prior knowledge
Basic concepts of mathematics and general chemistry.

Practical work "Structure of matter"

Lab No. 1: Preliminary practical work: Safety in the chemistry laboratory and description of equipment and glassware.
Lab No. 2: Changes in the state of water: Transition from liquid to solid and from liquid to vapor.
Lab No. 3: Determining the quantity of matter.
Lab No. 4: Determining molecular mass.
Lab No. 5: Calculating uncertainties - Determining ionic radius.
Lab No. 6: Determining partial molar volumes in a binary solution.
Lab No. 7: Qualitative analysis of cations (1st, 2nd, 3rd, and 4th groups).
Lab No. 8: Qualitative analysis of anions.
Lab No. 9: Identification of metal ions using the flame test method.
Lab No. 10: Separation and recrystallization of benzoic acid.
Lab No. 11: Construction and study of several compact structures.
Lab No. 12: Study of ionic structures.

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

Semester: 1
Teaching unit: UEM 1.1
Subject 3: Computer structure and applications
SH: 45h00 (Lecture: 1h30, Practical Work: 1h00)
Credits: 2
Coefficient: 2

Objective and recommendations:
The objective of the course is to enable students to learn how to program using an advanced language (Fortran, Pascal, or C). The choice of language is left to the discretion of each institution. The concept of algorithms must be implicitly addressed during language learning.

Recommended prior knowledge:
Basic concepts of web technology.

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

Part 2. Concepts of algorithms and programs (10 weeks)
1- Concept of an algorithm
2- Flowchart representation
3- Structure of a program
4- Problem-solving approach and analysis
5- Data structure: Constants and variables, Data types
6- Operators: assignment operators, relational operators, logical operators, arithmetic operations, operation priorities
7- Input/output operations
8- Control structures: Conditional control structures, Repetitive control structures
Computer Science Practical Work 1:
The practical work aims to illustrate the concepts taught during the course. It should begin with the courses according to the following schedule:
• Practical work introducing and familiarizing students with computers from a hardware and operating system perspective (exploring the different features of operating systems)
• Practical work introducing the use of a programming environment (editing, assembly, compilation, etc.)
• Practical work applying the programming techniques covered in class.

Assessment method:
Continuous assessment: 40%; 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.

Semester: 1
Teaching unit: UET 1.1
Subject: Ethical and deontological dimension (foundations)
SH: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient : 1

Teaching objectives:
The main objective of this course is to facilitate students' immersion in student life and their transition to responsible adulthood. It helps develop students' awareness of ethical principles. It introduces them to the rules governing university life (their rights and obligations towards the university community) and the world of work, raises awareness of the importance of respecting and valuing intellectual property, and explains the risks of moral evils such as corruption and how to combat them.

Recommended prior knowledge:

None

Course content:

I. Fundamental Concepts – (2 weeks)
Definitions:
1. Morality:
2. Ethics:
3. Professional ethics "Duty Theory":
4. Law:
5. Distinction between different concepts
A. Distinction between ethics and morality
B. Distinction between ethics and professional ethics
II. Reference Frameworks – (2 weeks)
Philosophical references
Religious references
The evolution of civilizations
Institutional references
III. The University Campus – **الحرم الجامعي** (3 weeks)
The concept of university franchises
Regulatory texts
University franchise fees
Actors on the university campus
IV. University values – **القيم الجامعية** (2 weeks)
Social values
Community values
Professional values
V. Rights and duties (2 weeks)
Student rights
Student responsibilities
Teachers' rights
Obligations of professors and researchers
Obligations of administrative and technical staff

VI. University Relations (2 weeks)
Definition of the concept of university relations
Student-teacher relations
Student-student relations
Student-staff relations
Student-association member relations
VII. Practices (2 weeks)
Best practices for teachers
Best practices for students

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 .

Semester: 1
Teaching unit: UED 1.1
Subject 3: Careers in science and technology
SH: 22H30 (Lecture: 1h30)

Credits: 1
Coefficient: 1

Pré requis :	Néant

Objectives:

First, to introduce the student to all the fields covered by the Science and Technology Domain, and second, to a range of professions resulting from these fields. In the same context, this subject introduces new challenges of sustainable development as well as new professions that may arise from them.

Subject content:

What are engineering sciences?

The engineering profession, history and challenges of the 21st century, Searching for a job/recruitment announcement by keyword, developing a simple job description (job title, company, main activities, required skills (knowledge, know-how, interpersonal skills).

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

Definitions, application areas (Home automation, embedded applications for automotive, Video surveillance, Mobile telephony, Fiber optics, Advanced scientific instrumentation, Medical imaging and instrumentation, Giant mirrors, Contact lenses, Transport and Distribution of electrical energy, Power plants, Energy efficiency, Maintenance of industrial equipment, Elevators, Wind turbines, …

Role of the specialist in these fields.

Fields of Automation and Industrial Engineering:

Definitions, application areas (Automated industrial lines, Numerical Control machine tools, Robotics, Inventory management, Freight traffic management, Quality,

Role of the specialist in these fields.

Fields of Process Engineering, Hydrocarbons and Petrochemical Industries:

Definitions, Pharmaceutical industry, Agri-food industry, Leather and textile industry, Biotechnology, Chemical and petrochemical industry, Plastics industry, Energy sector (oil, gas), …

Role of the specialist in these fields.

Fields of Industrial Health and Safety (IHS) and Mining Engineering:

Definitions and application areas (Safety of property and persons, Environmental problems, Exploration and Exploitation of mining resources, …)

Role of the specialist in these fields.

Fields of Climate Engineering and Transport Engineering:

Definitions, application areas (Air conditioning, Smart buildings, Transport safety, Traffic management and road, air, naval transport, …)

Role of the specialist in these fields.

Fields of Civil Engineering, Hydraulics and Public Works: (2 weeks)

Definitions and application areas (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, …)

Role of the specialist in these fields.

Fields of Aeronautics, Mechanical Engineering, Marine Engineering and Metallurgy:

Definitions and application areas (Aeronautics, Avionics, Automotive industry, Ports, Dykes, Production of industrial equipment, Steel industry, Metal processing, …)

Role of the specialist in these fields.

Group work:

Development of job descriptions for professions in each field based on recruitment announcements found on job search sites (e.g. www.onisep.fr, www.indeed.fr, www.pole-emploi.fr) (1 field / group).

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

Student personal work for this subject:

The teacher in charge of this subject can inform students that they can always be evaluated by proposing to prepare profession fact sheets. Ask students to watch at home a scientific popularization film related to the chosen profession (after providing them with either the film on electronic media or the internet link to this film) and ask them to then submit a written report or make an oral presentation of the summary of this film, … etc. The bonus for these activities is left to the appreciation of the teacher and the training team who are alone capable of defining the best way to take this personal work into account in the overall grade of the exam.

Assessment mode:

Continuous assessment, Exam.

Bibliographic references:

[1] Quels métiers pour demain ? Éditeur : ONISEP, 2016, Collection : Les Dossiers.

[2] J. Douënel et I. Sédès, Choisir un métier selon son profil, Editions d'Organisation, Collection : Emploi & carrière, 2010.

[3] V. Bertereau et E. Ratière, Pour quel métier êtes-vous fait ? Editeur : L'Étudiant, 6e édition, Collection : Métiers, 2015.

[4] Le grand livre des métiers, Éditeur : L'Étudiant, Collection : Métiers, 2017.

[5] Les métiers de l'industrie aéronautique et spatiale, Collection : Parcours, Edition : ONISEP, 2017.

[6] Les métiers de l'électronique et de la robotique, Collection : Parcours, Edition : ONISEP, 2015.

[7] Les métiers 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: UEF 1.2

Subject: Analysis 2
SH: 67h30 (Lecture: 1h30, Tutorial: 3h00)
Credits: 6
Coefficient: 3

Prerequisites:
It is recommended that students have a good grasp of the fundamentals of integral and primitive calculus and the mathematics taught in S1.

Objectives:
This subject is of paramount importance for scientists and enables students to acquire:
• the methods for solving differential equations required for problems encountered in engineering and physics
• methods for calculating the derivability and integrals of functions with several variables (surfaces, volumes), and the different forms of limited development.

Course content:

Chapter 1: Ordinary differential equations
1. First-order ordinary differential equations
1.1 Historical note.
1.2 Physical model leading to a differential equation.
1.3 General definitions
1.4 General concepts of first-order differential equations.
□□General solution. Particular solution.
1.5 Separable and separable equations.
1.6 First-order homogeneous equations. Definitions and examples.
□□Solving the homogeneous equation.
1.7 Equations reducible to homogeneous equations.
□□Solving the linear equation.
1.8 Bernoulli equation.
□□Definition. Solving Bernoulli's equation.
2. Second-order differential equations
2.1 Historical note.
2.2 Homogeneous linear equations. Definitions and general properties.
2.3 Second-order homogeneous linear equations with constant coefficients
The roots of the characteristic equation are real and distinct.
The roots of the characteristic equation are complex.
The characteristic equation has a double real root.
2.4 Homogeneous linear differential equations of order n with constant coefficients.
Definition. General solution. General method for calculating n linearly independent solutions to the homogeneous equation.
2.5 Non-homogeneous linear equations of the second order.
Method of variation of arbitrary constants.
2.6 Non-homogeneous linear equations of the second order with constant coefficients.
Cases where the second member is of the form
a. The number n is not a root of the characteristic equation:
b. is a simple root of the characteristic equation:
c. is a double root of the characteristic equation:
Cases where the second member is of the form

a. if n is not a root of the characteristic equation:
b. if is a root of the characteristic equation:

Chapter 2: Functions of several variables. Concepts of limits, continuity, partial derivatives, differentiability
2.1 Historical note
2.2 Domain of definition.
2.3 Concept of limits.
Introduction. Concept of neighborhood. Definition of the limit of a function of two variables. Do not confuse limit in a direction with limit.
2.4 Continuity of functions of two variables.
2.5 First-order partial derivatives.
Definition of first-order partial derivatives of a function of two variables at a point (x_0,y_0)
Partial derivatives. Second-order partial derivatives. Continuity and existence of partial derivatives $((\partial f)/(\partial x))$ and $((\partial f)/(\partial y))$
2.6 Differentiable functions.
Introduction. Definition of differentiable functions. Case of functions of a real variable $f:\mathbb{R}\rightarrow\mathbb{R}$.
Definition of differentiable functions. Case of functions of two variables $f:\mathbb{R}^2\rightarrow\mathbb{R}$
Relationship between differentiable functions and the existence of partial derivatives $((\partial f)/(\partial x))$ and $((\partial f)/(\partial y))$. Relationship between differentiability and continuity.
2.7 Concept of differential of a function of two variables.
2.8 Partial derivatives of composite functions.
Partial derivatives of composite functions of type 1. Derivatives of composite functions of type 2.
2.9 Taylor's formula for functions of 2 variables.
Partial derivatives of order n, n>2.
2.10 Differentiable optimization in $\mathbb{R}^2$.
Definitions of local and global optimum. Necessary conditions for optimality. Sufficient conditions for optimality.

Chapter 3
1. Double integrals
1.1 Definition of the double integral
1.2 Examples
1.3 Properties of the double integral
- Linearity,
- Preservation of order,
- Additivity.

1.4 Fubini's theorem in the case of a bounded domain $\mathbb{R}$.
1.5 Calculation of double integrals
- Direct calculation,
- Change of variables in a double integral (Change of variables formula).

1.6 Applications: Center of gravity, Moment of inertia.
2. Triple integrals
2.1 Generalization of the concept of double integrals to triple integrals.
2.2 Calculation of a triple integral
- Direct calculation
- Calculation by change of variables (Formula for change of variables for a triple integral).
- Volume under the graph of a function of two variables.
- Calculation of the volume of certain solid bodies.

2.3 Applications: Center of gravity, moment of inertia.

Assessment method:
Written test, supervised assignment, final exam.

Bibliographic 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

Semester: 2
Teaching unit: UEF 1.2
Subject: Algebra 2
SH: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Prerequisites:
Algebra 1

Objectives:
Consolidate knowledge acquired in the first semester.
Study new concepts: sum of several vector subspaces, stable subspaces, trace.
Move from the geometric register to the matrix register and vice versa.

Course content:

Chapter 1: Vector spaces
Definition (on R and C).
Vector subspaces.
Sum of subspaces.
Additional subspaces.
Free family. Bound family. Basis (finite).

Chapter 2: Linear applications
Definition (operations).
Nucleus and image.
Rank of a linear application.
Rank theorem.
Characterization of injections, surjections, and bijections.

Chapter 3: Matrices, associated matrices, and determinants
Definition (as a table of numbers). Special matrices.
Operations on matrices. The vector space of matrices.
Determinants (definition (order 2, 3, and generalization) and properties).
Invertible matrix.
Matrix representation of a linear application.
Correspondence between operations on linear applications and those on matrices.
Basis change matrix (transition matrix).
Effect of a basis change on the matrix of a linear application.

Chapter 4: Systems of linear equations
Definitions and interpretations.
Cramer's systems (general case).

Chapter 5: Matrix reduction.
Eigenvalues.
Eigenvectors.
Characteristic polynomials. Cayley-Hamilton theorem.
Characterization of diagonalizable matrices.
Characterization of trigonizable matrices.
Applications of reduction.

Bi**bliographic references:**

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

Assessment methods:

Test, supervised assignment, final exam

Semester: 2
Teaching unit: UEF 1.2
Subject: Electricity and magnetism
SH: 67h30 (Lecture: 1h30 – Tutorial 3h00)
Credits: 6
Coefficient: 3

Prerequisites:

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

Objectives:

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

Course content:

Chapter 1: Electrostatic field and potential

- Point charge.
- Electric force and Coulomb's law.
- Electric field and potential (discontinuous charge distribution).
- Electric dipole: electric field and potential.
- Action of the electric field on a dipole (orientation and state of equilibrium).
- Electric field and potential (continuous charge distribution).
- Gauss's theorem.

Chapter 2: Conductors

- Basic properties.
- Induced charge and influence phenomena
- Electrostatic pressure. Capacitors, capacitance (different types), stored energy.

Chapter 3: Electric Current

- Concepts of current intensity and density.
- Resistance and Ohm's law, Joule's law.

Chapter 4: Magnetostatics

- Introduction.
- Magnetic force and Lorentz's law.
- Action of a magnetic field on an electric current.
- Magnetic field produced by a stationary current: Biot-Savart law.
- Circulation of the magnetic field.
- Rotational magnetic field and Ampere's law.
- Magnetic field

- Magnetic field flux through a closed loop and induction.
- Maxwell's equations.

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

Assessment methods:

Quizzes, supervised assignments, practical work reports, final exam.

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

Objectives:
The knowledge acquired enables students to characterize the behavior of liquid, solid, and gaseous substances and to evaluate their thermodynamic properties under different conditions (temperature, pressure, pure substances, ideal mixtures, and phase changes).

Course content

Chapter I: Basic concepts in thermodynamics
I.1 Mathematical review of partial derivatives
I.2 Properties and states of a system
I.3 Processes, equilibrium, and thermodynamic cycles
I.4 Density, specific volume,
I.5 Pressure, temperature, and energy
Chapter II: Thermodynamic properties of pure substances
II.1 The ideal gas
II.2 Actual behavior of gases
II.3 Corresponding states and residual deviations
II.4 Properties of liquids and solids
Chapter III: Fundamental concepts of thermodynamics
II.1 First law and applications
II.2 Entropy and second law
II.3 Entropy balance and irreversibility
II.4 Properties of free energy and thermodynamic equilibrium
II.5 Chemical potential and fugacity
Chapter IV: Equilibria of physical processes
IV.1 Phase equilibria of a pure substance
IV.2 Thermodynamic properties of phase transitions
IV.3 Ideal behavior of gas, liquid, and solid mixtures
IV.4 Phase equilibria of a compound in an ideal mixture
IV.5 Ideal solubility and partition coefficient

Bibliographic 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

Semester: 2
Teaching unit: UEM 1.2
Subject 1: Electricity and Magnetism Practical Work
SH: 45h00 (Practical Work: 1h30)
Credits: 2
Coefficient: 1

Teaching objectives

To consolidate the theoretical concepts covered in Physics 2 through practical work sessions.

Recommended prior knowledge

Mathematics 1, Physics 1.

Course content:

At least 5 experiments (3 hours / 15 days)

- Presentation of measuring instruments and tools (voltmeter, ammeter, rheostat, oscilloscopes, generator, etc.).

- Kirchhoff's laws (mesh law, node law).

- Thévenin's theorem.

- Association and measurement of inductances and capacitances.

- Charging and discharging a capacitor.

- Oscilloscope.

- Practical work on magnetism.

Assessment method:

Continuous assessment: 100%.

Semester: 2
Teaching unit: UEM 1.2
Subject: Thermodynamics Practical Work
SH: 22h30 (Practical Work: 3h00)
Credits: 2
Coefficient: 1

Pre-requisites:
None

Objectives:
The knowledge acquired enables students to characterize the behavior of liquid, solid, and gaseous substances and to evaluate their thermodynamic properties under different conditions (temperature, pressure, pure substances, ideal mixtures, and phase changes).

Practical work in thermodynamics:

LabNo. 1: Study of the equation of state of an ideal gas.
Lab No. 2: Water value of the calorimeter.
Lab No. 3: Specific heat: specific heat of liquids and solids.
Lab No. 4: Study of the solidification of pure water.
Lab No. 5: Latent heat: Latent heat of fusion of ice.
Lab No. 6: Determination of the latent heat of vaporization.
Lab No. 7: Heat of reaction: Determination of the energy released by a chemical reaction (HCl/NaOH).
Lab No. 8: Thermodynamic functions of an acid-base equilibrium.
Lab No. 9: Study of the variation in pressure as a function of temperature at equilibrium (l-g) for a pure system: water.
Lab No. 10: Vapor pressure of a solution.
Lab No. 11: Equilibrium diagram for a binary system.
Lab No. 12: Equilibrium diagram for a ternary system.

Assessment methods:

Quizzes, supervised assignments, lab reports, final exam.

Semester: 2
Teaching unit: UEM 1.2
Subject 3: Introduction to programming
SH: 45h00 (Lecture: 1h30, Practical Work: 1h00)
Credits: 2
Coefficient: 2

Course 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 for programming and code documentation

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

Course content:

Chapter 1: Introduction to computer science and programming (1 week)
- History of programming languages, concepts of algorithms and programming, the program development process, introduction to the development environment

Chapter 2: Structure of a C program and data types (2 weeks)
- Fundamental structure of a C program; variables and constants; primitive data types (int, float, double, char); arithmetic and logical operations

Chapter 3: Input/Output and expressions (2 weeks)
- Use of printf() and scanf() functions; Data formatting; Expressions and order of evaluation; Type conversions

Chapter 4: Conditional and iterative control structures (3 weeks)
- if-else statements Comparison operators Logical operators Switch-case structure While and do-while loops Form loops Nesting loops Break and continue statements

Chapter 5: Functions, Arrays, and Character Strings (3 weeks)
- Function definition and declarationm Parameter passingm Return valuesm Recursive functions, Array declaration and usagem Multidimensional arraysm Character strings in Cm Standard functions for strings

Chapter 6: Pointers and dynamic allocation (2 weeks)
- Concept of memory addressm & and * operatorsm Memory allocation and freem Relationship between arrays and pointers

Chapter 7: Structures and enumerations (2 weeks)
- Definition of structured types m Access to members m Structure arrays m Enumerations

Detailed content of practical sessions
Lab 1: Getting started with the environment

- Installation of the IDE (Code::Blocks, Visual Studio Code with C extensions)
- First “Hello World” program
- Compilation and execution
- Correcting simple errors

Lab 2: Variables and expressions
- Declaring and initializing variables
- Arithmetic operators
- Simple calculations and displaying results

Lab 3: Conditional structures and iterative structures
- Implementing programs with

TP 3: Conditional Structures and Iterative Structures
- Implementing programs with if-else
- Using switch-case
- Comparison and logical operators
- Implementing while, do-while, and for loops
- Creating counters and accumulators
- Validating user input

Lab 4: Functions
- Creating and calling functions
- Passing parameters by value
- Organizing code into functions

Lab 5: One-dimensional and multidimensional arrays
- Manipulating arrays
- Searching and sorting (simple algorithms)
- Passing arrays to functions
- Creating and manipulating matrices
- Matrix operations

Lab 6: Character strings
- Manipulating strings with functions from the string.h library
- Text processing

Lab 7: Pointers and dynamic allocation
- Use of pointers
- Memory allocation and release
- Dynamic arrays

Lab 8: Files

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

Bibliographic 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*, 5eme 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, 2e édition, ENI, ISBN10 : 2746052563.
6. Online resources:
    - Learn C Programming on sur https://www.learn-c.org/
    - *C Programming* on https://www.tutorialspoint.com/cprogramming/

Semester: 2
Teaching unit: UET 1.2
Subject 1: Free and Open Source Software
SH: 45h00 (Lecture: 1h30 & Workshop: 1h30)
Credits: 2
Coefficient: 2

Teaching objectives:
This course aims to familiarize students with the free and open source software ecosystem, its philosophical and technical foundations, and its PW application as a replacement for 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

Course content:

Chapter 1: Fundamentals of free software (2 weeks)
- History of the free and open source software movement
- Difference between “free software” and “open source”
- Richard Stallman's philosophy and the GNU project
- Economic and social impact of free software in Algeria and around the world

Chapter 2: Legal framework and licenses (2 weeks)
- Introduction to copyright as it applies to software
- Main free licenses: GPL, LGPL, BSD, MIT, Apache
- Compatibility between licenses
- Implications for Algerian educational institutions and businesses

Chapter 3: Free operating systems (3 weeks)
- Introduction to GNU/Linux
- Presentation of distributions adapted to the educational context
- Installation principles and basic configuration
- Fundamental commands and package management

Chapter 4: Free office solutions (3 weeks)
- LibreOffice as an alternative to Microsoft Office
  - Writer (word processing)
  - Calc (spreadsheet)
  - Impress (presentation)
- Open document formats
- Migration of existing documents
- Configuration for the Algerian context (language, formats)

Chapter 5: Creative solutions and development (3 weeks)
- Graphics alternatives: GIMP, Inkscape
- Development tools: free IDEs, Git
- Web tools: free browsers, open source CMS
- Free databases: MySQL/MariaDB, PostgreSQL

Chapter 6: Prospects and future of free software (2 weeks)
- Open source communities and methods of contribution
- Economic models of free software
- Public policy and free software in Algeria
- Professional opportunities related to free software

Workshops

Workshop 1: Discovering Linux
- Installing a Linux distribution in a virtual machine
- Basic configuration and customization of the system
- Navigating the interface and using basic commands

Workshop 2: Software management in Linux
- Using package managers
- Installing and updating software
- Configuring software repositories

Workshop 3: Migrating to LibreOffice
- Installing and configuring LibreOffice
- Creating and editing documents with Writer
- Conversion of proprietary formats to open formats
- Creation of templates tailored to student needs

Workshop 4: Spreadsheets and presentations
- Advanced use of Calc (formulas, graphs)
- Creating presentations with Impress
- Compatibility with existing formats
- Collaborative work on documents

Workshop 5: Image processing and graphics
- Using GIMP for image editing
- Graphic design with Inkscape
- Comparison with corresponding proprietary tools
- Completing a simple graphic design project

Workshop 6: Free web and databases
- Installation and configuration of an open source CMS (WordPress, Joomla)
- Configuration of a MariaDB database
- Creation of a simple website
- Basic security

Workshop 7: Collaborative development
- Using Git for version management
- Configuring an open-source development environment
- Participating in a mini collaborative project
- Using a software forge (GitHub, GitLab)

Assessment method: exam 60% and practical work assessment 40%

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: UEF 2.1
Subject: Analysis 3
SH: 67h30 (Lecture: 1h30, Tutorial: 3h00)
Credits: 6
Coefficient: 3

Prerequisites:
A good knowledge of the analysis of real variable functions and the basics of matrix calculus.

Objectives:
This course is an introduction to scientific computing. Its objectives are to:
- Present basic numerical methods for solving concrete engineering problems using a computer.
- Identify the difficulties associated with solving real-world problems numerically on a computer.
- Learn how to develop and implement methods for discretizing continuous problems.
- Master and know how to implement the basic techniques of numerical matrix analysis.
- Know how to implement the basic techniques of numerical calculation.

Course content:

Chap. 1 Introduction to numerical analysis (Lecture: 6 hours)
1.1. Sources of error: modeling errors, data errors, approximate values, error propagation, relative and absolute error, floating-point arithmetic, IEEE-754 standard, rounding errors, truncation error, exact significant digits, risky operations.
1.2. Conditioning and stability: examples of numerical instabilities, conditioning of a problem.
1.3. Methods and algorithms: exact methods, approximate methods, iterative methods.

Chap. 2 Solving nonlinear equations (Lecture: 6 hours, Tutorial: 4.5 hours)
2.1. Functions of a real variable: localization and root separation theorems.
2.2. Classical methods: dichotomy method, secant method, stopping criteria.
2.3. Iterative methods: fixed point method, Newton's method, order of convergence, stopping criteria.

Chap. 3 Solving linear systems (Lecture: 9:00 a.m., Tutorial: 6:00 a.m.)
3.1. Direct methods: upper (or lower) triangular matrix, symmetric matrices (definitions and properties), Gauss elimination method, LU factorization (Crout, Doolittle), Cholesky factorization (positive definite symmetric matrix).
3.2. Numerical algebra vocabulary: vector norms, matrix norms, matrix conditioning (definitions and properties), spectral radius, example of an ill-conditioned linear system.
3.3. Iterative methods: Jacobi methods, Ga

Practical Work:
- Getting started with Matlab
- Solving nonlinear equations
- Solving linear systems: Direct methods
- Solving linear systems: Iterative methods

Bibliographical references:
[1] Jean-Pierre Demailly, ANALYSE NUMÉRIQUE ET ÉQUATIONS DIFFÉRENTIELLES, EDP Sciences (2006).
[2] Alfio Quarteroni, Riccardo Sacco, Fausto Saleri, MÉTHODES NUMÉRIQUES : ALGORITHMES, ANALYSE ET APPLICATIONS, Springer-Verlag (2007).
[3] Alfio Quarteroni, Fausto Saleri, Paola Gervasio, CALCUL SCIENTIFIQUE : COURS, EXERCICES CORRIGÉS ET ILLUSTRATIONS EN MATLAB ET OCTAVE, Springer-Verlag (2010).

[4] Won Young Yang, Wenwu Cao, Tae-Sang Chung, APPLIED NUMERICAL METHODS USING MATLAB, John Wiley end Sons (2005).
[5] Jean-Louis Merrien, ANALYSE NUMÉRIQUE AVEC MATLAB, Dunod (2007).
[6] André Fortin, ANALYSE NUMÉRIQUE POUR INGÉNIEURS, Presses internationales Polytechnique (2011).
[7] William Ford, NUMERICAL LINEAR ALGEBRA WITH APPLICATIONS USING MATLAB, Elsevier Inc (2015).
[8] Cleve B. Moler, NUMERICAL COMPUTING WITH MATLAB, Siam (2004).
[9] Grégoire Allaire, Sidi Mahmoud Kaber, NUMERICAL LINEAR ALGEBRA, Springer (2008).
[10] Luc Jolivet, Rabah Labbas, ANALYSE ET ANALYSE NUMÉRIQUE : RAPPEL DE COURS ET EXERCICES CORRIGÉS, Lavoisier (2005).
[11] Jacques Rappaz, Marco Picasso, INTRODUCTION A L'ANALYSE NUMÉRIQUE, Presses polytechniques et universitaires romandes (2004).
[12] Nicholas J. Higham, ACCURACY AND STABILITY OF NUMERICAL ALGORITHMS, siam (1996).
[13] John Hubbard, Florence Hubert, CALCUL SCIENTIFIQUE DE LA THÉORIE A LA PRATIQUE : ILLUSTRATIONS AVEC MAPLE ET MATLAB, Université de Provence, Marseille (2005).

Semester: 3
Teaching unit: UEF 2.1
Subject: Waves and Vibrations
SH: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

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

Recommended prior knowledge
Mathematics 2, Physics 1, and Physics 2

Course content:
Preamble: This subject is divided into two parts, Waves and Vibrations, which can be studied independently of each other. In this regard, and due to the consistency of this subject in terms of content, it is advisable to study this subject in the following order: Waves and then Vibrations for students in the Electrical Engineering program (Group A). For students in Groups B and C (Civil Engineering, Mechanical Engineering, and Process Engineering), it is advisable to start with Vibrations. In any case, the teacher is expected to do their best to cover both parts. We remind you that this subject is intended for engineering professions in the field of Science and Technology. Teachers are therefore asked to skim over all parts of the course that require demonstrations or theoretical explanations and to focus solely on the practical aspects. Demonstrations can be assigned to students as additional work to be completed as part of their personal study. See the section entitled "G- Student assessment through continuous assessment and personal work" in this course description.

Part A: Vibrations
Chapter 1: Introduction to Lagrange equations 2 weeks
1.1 Lagrange equations for a particle
1.1.1 Lagrange equations
1.1.2 Conservative systems
1.1.3 Speed-dependent friction forces
1.1.4 Time-dependent external forces
1.2 Systems with multiple degrees of freedom.

Chapter 2: Free oscillations of systems with one degree of freedom 2 weeks
2.1 Undamped oscillations
2.2 Free oscillations of damped systems

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

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

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

5.1 Lagrange equations
5.2 Mass-spring-damper system
5.3 Impedance
5.4 Applications
5.5 Generalization to systems with n degrees of freedom

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

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

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

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

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

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.

Semester: 3
Teaching unit: UEF 2.1
Subject: Fluid mechanics
SH: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course objective:

Introduce students to the field of fluid mechanics. Fluid statics will be covered in detail in the first part. Then, in the second part, the study of non-viscous fluid motion will be considered.

Recommended prior knowledge: mathematics, integral calculus,

Chapter 1: General information on fluid mechanics. (2 weeks)

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

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

II.1 Density; II.2 Isothermal compressibility; II.3 Surface tension; II.4 Viscosity;

II.5 Mathematical problems in fluid mechanics; II.6 Particle derivatives; II.7 Boundary conditions; II.8 Dimensions, dimensional equations, and units.

Chapter 3: Hydrostatics. (3 weeks)

III.1 Fundamental law of hydrostatics; III.2 Hydrostatic pressure in an incompressible fluid.

III.3 Compressible fluid: ideal gas, III.4 Resultant of hydrostatic pressure forces; III.5 Force exerted on a wall by a fluid; III.6 Archimedes' principle.

Chapter 4: Conservation of mass. (2 weeks)

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

Chapter 5: Ideal Fluid. (5 weeks)

V.1 Mechanics Review; V.2 Momentum Theorem; V.3 Euler's Equations; V.4 Bernoulli's theorem; V.5. Examples of applications of Bernoulli's theorem: Pitot tube; Venturi nozzle; Unsteady emptying of a tank; V.6 Air exhaust from a pressurized tank: compressibility limit.

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

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

Bibliographical references:

R.Comolet,'Mécanique des fluides expérimentale', Tomes 1, 2 et 3, Ed. Masson et Cie.
R.Ouziaux, 'Mécanique des fluides appliquée', Ed.Dunod,1978
B.R.Munson,D.F.Young,T.H.Okiishi,'Fundamentals of fluid mechanics', Wiley & sons .R.V.Gilles,'Mécaniquedesfluidesethydraulique:Cours et problèmes',SérieSchaum,McGrawHill,1975.
C.T.Crow,D.F.Elger,J.A.Roberson,'Engineering fluid mechanics', Wiley & sons
R.W.Fox,A.T.McDonald,'Introduction to fluid mechanics', fluid mechanics'
V.L.Streeter,B.E.Wylie,'Fluid mechanics', McGrawHill
F.M.White,''Fluid mechanics', McGrawHill
S. Amiroudine, J. L. Battaglia, 'Mécanique des fluides Cours et exercices corrigés', Ed.Dunod
-N. Midoux, Mécanique et rhéologie des fluides en génie chimique, *Ed. Lavoisier, 1993*.
- M. Fourar, Equations générales, solides élastiques, fluides, turbomachines, similitude, *Ed. Ellipses, 2ème Edition 2015*.

Semester: 3
Teaching unit: UEF 2.1
Subject 1: Inorganic chemistry
SH: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
Provide basic concepts of inorganic chemistry.
Teach several methods such as crystal chemistry and synthesis.

Recommended prior knowledge
Basic concepts of general chemistry.

Course content

Chapter 1: Review of several important definitions: 1 week
Mole, molar mass, molar volume, molar fraction, mass fraction, volume fraction; density; relationship between mass fraction and molar fraction; material balance: concept of reactant and excess reactant, concept of excess percentage, concept of conversion percentage

Chapter 2: Crystal chemistry 3 weeks
Polyhedral description of structures, connectivity.

Chapter 3: Periodicity and in-depth study of the properties of elements: 3 weeks
Halogens, chalcogens, nitrogen and phosphorus, boron.

Chapter 4: Major metallurgy 4 weeks
(Fe, Ti, Cu, Mg)

Chapter 5: Major mineral syntheses 4 weeks
(H2SO4, H3PO4, NH3, HNO3)

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

Bibliographical references:
Ouahès, R, Devallez, B. Chimie Générale. Exercices et Problèmes enseignement supérieur 1er cycle. Edition Publisud.
Winnacker Karl 1903. Technologie minérale. Edition Eyrolles 1962, cop 1958. Traité de chimie appliquée : Chimie inorganique, Chimie industrielle, Industries chimiques, Génie Chimique.

Semester: 3
Teaching unit: UEM 2.1
Subject: Probability and statistics
SH: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Course objectives

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

Recommended prior knowledge

Algebra, Analysis 1 and 2

Course content:

Part A: Statistics

Chapter 1: Basic definitions (1 week)

A.1.1 Concepts of population, sample, variables, modalities

A.1.2 Different types of statistical variables: qualitative, quantitative, discrete, continuous.

Chapter 2: Statistical series with one variable (3 weeks)

A.2.1 Count, frequency, percentage.

A.2.2 Cumulative count, cumulative frequency.

A.2.3 Graphical representations: strip chart, pie chart, bar chart. Frequency polygon (and frequency polygon). Histogram. Cumulative curves.

A.2.4 Position characteristics

A.2.5 Dispersion characteristics: range, variance and standard deviation, coefficient of variation.

A.2.6 Shape characteristics.

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

A.3.1 Data tables (contingency table). Scatter plots.

A.3.2 Marginal and conditional distributions. Covariance.

A.3.3 Linear correlation coefficient. Regression line and Mayer's line.

A.3.4 Regression curves, regression corridor, and correlation ratio.

A.3.5 Functional adjustment.

Part B: Probability

Chapter 1: Combinatorial Analysis (1 week)

B.1.1 Arrangements

B.1.2 Combinations

B.1.3 Permutations.

Chapter 2: Introduction to Probability (2 weeks)

B.2.1 Algebra of events

B.2.2 Definitions

B.2.3 Probability spaces

B.2.4 General probability theorems

Chapter 3: Conditioning and independence (1 week)

B.3.1 Conditioning,

B.3.2 Independence,

B.3.3 Bayes' theorem.

Chapter 4: Random variables (1 week)

B.4.1 Definitions and properties,

B.4.2 Distribution function,

B.4.3 Mathematical expectation,

B.4.4 Covariance and moments.

Chapter 5: Common discrete and continuous probability distributions (3 weeks)

Bernoulli, binomial, Poisson, etc.; uniform, normal, exponential, etc.

Assessment method:

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

Références bibliographiques:

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

Semester: 3
Teaching unit: UEM 2.1
Subject: Python Programming
SH: 45h00 (Tutorial 1h30, Practical Work 1h30)
Credits: 2
Coefficient: 2

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

Recommended prior knowledge:
- No prior programming experience is required
- Basic knowledge of mathematics (high school level)
- Know how to use a computer (file navigation, text editor)

Course content:

Chapter 1. Installing and using Python
Chapter 2. Basic concepts
2-A. Interactive mode and script mode ,
2-A-1. Python calculator,
2-A-2. Using operators: +, -, *, /, //, %, and **,
2-A-3.c Priority
2-B. Variables and data types:
2-B-1. Initializing variables, Modifying variables, Compound assignment
2-B-2. Data types: (. Number, Character, String)
2-B-3. Conversion (str function)
2-C. Predefined functions
2-C-1. Using functions from the math module (abs, max, min, pow, round, sin, sqrt, log, exp, acos, etc.)
2-C-2. Print function
2-C-3. Formatted output (using the format function)
2-C-4. Input function
2-C-5. Importing functions
2-D. Source code
2-D-1. Variable naming rules
2-D-2. Comments

Chapter 3. Conditional structures
(Minimal if form, if-else form, complete if-elif-else form)
The limitations of simple if conditions
Comparison operators
Predicates and Booleans
The keywords and, or, and not

Chapter 4. Loops
The while loop
The for loop
Nested loops
The keywords break and continue

Chapter 5. Functions
Creating functions
Default parameter values
Function signature
The return statement
Modules,
The import method
The import method: from … import …
Packages
Importing packages
Creating your own packages

Chapter 6: Lists and tuples
Creating and editing lists
Defining a list, Creating lists
Inserting objects into a list
Adding an element to the end of the list
Inserting an element into the list
Concatenating lists
Deleting elements from a list
The del keyword
The remove method
Iterating over lists
The enumerate function
Creating tuples

Chapter 7: Dictionaries
Creating and editing dictionaries
Creating a dictionary
Deleting keys from a dictionary
Iteration methods
Iterating over keys
Iterating over values
Iterating over keys and values simultaneously
Dictionaries and function parameters

Chapter 8: Objects and Classes
Describe objects and classes, and use classes to model objects.
Define classes with data fields and methods.
Construct an object using a constructor that invokes the initializer to create and initialize the data fields.
Chapter 9: Files
Relative and absolute paths
Reading and writing to a file

Opening the file
Closing the file
Reading the entire file
Writing to a file
Writing other types of data
The keyword with
Saving objects to files
Saving an object to a file

Assessment method: Continuous assessment, practical work, final exam

Bibliographical references:

[1] . Allen B. Downey Think Python: How to Think Like a Computer Scientist, O'Reilly Media, 2015;
[2] . Zed A. Shaw Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, Addison-Wesley Professional, 2017;
[3] . Barry, P. Head first Python: A brain-friendly guide. " O'Reilly Media, Inc.", 2016;
[4] Ramalho, L. Fluent Python. O'Reilly Media, Inc., 2022;
[5] Swinnen, G. Learn to program with Python 3. Editions Eyrolles, 2012;
[6] . Le Goff, V.. Learn to program in Python. Editions Eyrolles, 2019;
[7] . Matthes, E. Python crash course: A hands-on, project-based introduction to programming. No Starch Press, 2019;

Practical work:
Practical 1: Getting started with the Python environment (1 week)
1. Installing Python and a code editor (VS Code, PyCharm)
2. Getting started with the Python interpreter
    - Executing simple commands in interactive mode
    - Using Python as a calculator
3. Creating and executing your first Python script

Practical work 2: Variables, data types, and operations (1 week)
1. Working with fundamental data types
    - Integers, floats, character strings, Booleans
    - Conversion between data types
2. Arithmetic operations and priorities

PW 3: Conditional and repetitive structures (1 week)
1. Conditional statements (if, elif, else)
2. Loops (for, while)

PW 4: Functions and modularity (1 week)
1. Defining and calling functions
2. Parameters and return values

PW 5: Data structures (1 week)
1. Manipulating lists
2. Dictionaries and tuples
3. Traversing and manipulating data structures

PW 6: File manipulation and final project (1 week)
1. Reading and writing text files
2. Final project of your choice:
    - Command line task manager
    - Hangman game

- Data analysis from a CSV file
- Interactive quiz with score saving

Assessment method:
Continuous assessment: 100%.

Bibliographic references:

1. Cyrille, H. (2018). Apprendre à programmer avec Python 3. Eyrolles, 6ème édition. ISBN: 978-2212675214
2. Daniel, I. (2024). Apprendre à coder en Python, J'ai lu
3. Nicolas, B. (2024). Python, du grand débutant à la programmation objet Cours et exercices corrigés, 3eme édition, Ellipses
4. Ludivine, C. (2024). Selenium Maîtrisez vos tests fonctionnels avec Python, Eni
5. Lutz, M. (2013). Learning Python, 5ème edition O′Reilly. ISBN: 978-1449355739

Online resources

- Python documentation: docs.python.org
- Python exercises on Codecademy ; codecademy.com/learn/learn-python-3
- W3Schools Python Tutorial : w3schools.com/python/

Semester: 3
Teaching unit: UEM 2.1.4
Subject: Waves and vibrations Practical Work
SH: 22h30 (Practical Work: 1h00)
Credits: 1
Coefficient: 1

Teaching objectives
The objectives of this program are to introduce students to the practical application of their knowledge of mechanical vibrations limited to low-amplitude oscillations for one or two degrees of freedom, as well as the propagation of mechanical waves.

Recommended prior knowledge
Vibrations and waves, Mathematics 2, Physics 1, Physics 2.

Course content:

PW1: Mass-spring
PW2: Simple pendulum
PW3: Torsion pendulum
PW4: Free and forced oscillating electrical circuits
PW5: Coupled pendulums
PW6: Transverse oscillations in vibrating strings
PW7: Hoffmann groove pulley
PW8: Electromechanical systems (electrodynamic loudspeaker)
PW9: Pohl's pendulum
PW10: Propagation of longitudinal waves in a fluid.

Note: It is recommended that you choose at least 5 practicals from the 10 offered.

Assessment method:
Continuous assessment: 100%.

Bibliographical references:

Semester: 3
Teaching unit: UEM 2.1
Subject 3: Technical drawing
SH: 22h30 (Practical Work: 1h30)
Credits: 2
Coefficient: 1

Course objectives
This course will enable students to acquire the principles of representing parts in industrial drawing. Furthermore, this subject will enable students to represent and read plans.

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

Course content

Chapter 1: General information. 2 weeks
1.1 Usefulness of technical drawings and different types of drawings.
1.2 Drawing materials.
1.3 Standardization (types of lines, writing, scale, drawing format and folding, title block, etc.).

Chapter 2: Elements of descriptive geometry 6 weeks
2.1 Concepts of descriptive geometry.
2.2 Orthogonal projections of a point - Drafting a point - Orthogonal projections of a line (any and specific) - Drafting a line - Traces of a line - Projections of a plane (any and specific positions) - Traces of a plane.
2.3 Views: Choice and arrangement of views - Dimensioning - Slope and taper - Determining the third view from two given views.
2.4 Method for executing a drawing (layout, 45° line, etc.)
Application exercises and assessment (practical work)

Chapter 3: Perspectives 2 weeks
Different types of perspectives (definition and

Chapter 3: Perspectives 2 weeks
Different types of perspectives (definition and purpose).
Application exercises and assessment (practical work).

Chapter 4: Cross-sections and sections 2 weeks
4.1 Cross-sections, standard representation rules (hatching).
4.2 Projections and sections of simple solids (projections and sections of a cylinder, prism, pyramid, cone, sphere, etc.).
4.3 Half-cuts, partial cuts, broken cuts, sections, etc.
4.4 Technical vocabulary (terminology of machined shapes, profiles, piping, etc.).
Application exercises and assessment (practical work).

Chapter 5: Dimensioning 2 weeks
5.1 General principles.
5.2 Dimensioning, tolerance, and adjustment.
Application exercises and assessment (practical work).

Chapter 6: Concepts of definition and assembly drawings and parts lists.

1 week

Application exercises and assessment (practical work).

Assessment method:
Continuous assessment: 100%.

Bibliographical references:
(Depending on the availability of documentation at the institution, websites, etc.)

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

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

Semester: 3
Semester: 4
Teaching unit: UED 2.1
Subject 1: HSE Industrial installations
SH: 22h30 (Lecture: 1h30)
Credits: 1
Coefficient: 1

Teaching objectives

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

Recommended prior knowledge

Course content

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

1.1 Understand basic concepts (hazard, risk) and identify those involved in prevention;
1.2 Master indicators relating to workplace accidents (frequency rate, severity rate, etc.) and occupational illnesses;
1.3 Observe and analyze the risks associated with a work situation;
1.4 Develop a cause tree;

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

2.1 Identify the main aspects of hygiene and public health;
2.2 Understand the concepts of housing hygiene;
2.3 Understand the main areas of environmental protection;
2.4 Understand the issue of sustainable development;
2.5 Identify the role and mission of the various organizations in the field of occupational health and safety and public health.

Assessment method: Final exam: 100%.

Bibliographical references: (Depending on the availability of documentation at the institution, websites, etc.)

Semester: 4
Teaching unit: UEF 2.2.1
Subject 1: Chemistry of solutions
SH: 45 hours (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient: 2

Teaching objective:
The aim is to provide students with a basic understanding of solution chemistry.
The main purpose of this course is to familiarize students with the principles of solution chemistry so that they can subsequently predict chemical reactions for analytical purposes. The main focus is on:
- Understanding the concepts of electrolytes and solution conductivity.
- Knowing how to calculate the pH of an aqueous solution.
- Understanding the concepts of oxidants and reductants and predicting oxidation-reduction reactions.

Recommended prior knowledge: Basic concepts of general chemistry.

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

Chapter 2: Acids-Bases 3 weeks
Acid-base equilibria in aqueous solution: acidity scale, acidity constant (Ka, pKa), dilution law (Oswald), pH calculation (simple solutions, mixtures, saline solutions, buffer solutions, ampholyte solutions), reaction predictions, acid-base titrations (polyacids and polybases).
- Color indicators

Chapter 3: Oxidation-reduction 3 weeks
Definition, Oxidizing agent, reducing agent, Redox reactions, Oxidation state and number, Balancing redox reactions, Electrochemical cells, Thermodynamic aspects, Electrodes

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

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

Assessment method:
Continuous assessment: 40%; Final exam: 60%.
References:
1- John Hill , Ralph Petrucci, Terry McCreary , Scott Perry, Chimie des Solutions, 2ème Ed, , Edition ERPI ; 2014.
2- John C. Kotz, Chimie des Solutions, Edition de Boeck 2006.

Semester: 4
Teaching unit: UEF 2.2.1
Subject 1: Organic chemistry
SH: 45 hours (Lectures: 1.5 hours, tutorials: 1 hour)
Credits: 4
Coefficient: 2

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

Recommended prior knowledge:
Basic knowledge of carbon, concepts of chemical bonding.

Course content:

Chapter 1: General information 3 weeks
Study of the carbon atom and its bonds
Functions and nomenclature of organic compounds: Ordinary, trivial, usual, and systematic IUPAC nomenclature

Chapter 2: Classification of organic functions 2 weeks
Saturated aliphatic hydrocarbons (linear, branched), alkenes (preparation, reactivity), aromatic compounds (preparation, reactivity), alcohols, thiols, aldehydes (preparation, reactivity), ketones, carboxylic acids (preparation, reactivity).

Chapter 3: Concepts of Stereoisomerism 4 weeks
Definition, Planar Isomerism (definition), Functional Isomerism, Position Isomerism, Tautomerism, Geometric Isomerism, Stereochemistry: definition, representation of molecules in space, configurational isomerism.

Chapter 4: Electronic Effects 3 weeks
-Definition, Chemical bonds: pure covalent, polarized covalent, and ionic. Inductive effect: definition, classification of inductive effects, influence of the inductive effect on the acidity of a chemical compound, influence of the inductive effect on the basicity of a chemical compound. Mesomeric effect: definition, conjugated systems and electron delocalization. Classification of mesomeric effects, influence of mesomeric effects on the acidity of a chemical compound, influence of mesomeric effects on the basicity of an organic compound

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

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

Practical work No. 1. Esterification (synthesis of aspirin).
Practical work No. 2. Purification of benzoic acid by recrystallization.
Practical work No. 3. Extraction of an organic product.
Practical work No. 4. Determination of the composition of a mixture by refractometry.
Practical work No. 5. Sublimation of naphthalene.
Practical work No. 6. Study of the properties of phenol or an organic substance.

Practical work No. 7. Preparation of soap.
Practical work No. 8. Transformation of an alcohol into a halogenated derivative (synthesis of 2-chloro-2-methylpropane from 2-methylpropan-2-ol).
Practical work No. 09: Purification by atmospheric pressure distillation and steam stripping
Practical work No.10: Purification by fractional column distillation

Reference:

1-PaulArnaud, Chimie organique, DUNOD;2004.
2-Jean pierre Mercier ,Pierre Gaudard Chimie organique: une initiation; Presses polytechniques Romandes 2001.
3- Melania Kiel Chimie organique cours et exercices corrigés; estem ; 2004.
4- Jonathan Clayden, Nick Greeves, Stuart Warren,André Pousse,Chimie organique; deBoeck2eédition;2013.
5- JohnMcMurry,EricSimanek,Chimie organique les grands principes ; DUNOD 2e édition; 2007.

Semester: 4
Teaching unit: UEF 2.2.2
Subject 1: Chemical thermodynamics
SH: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient: 2

Teaching objectives:
-Mastery of the first, second, and third laws of thermodynamics.
-Application of thermodynamic principles.
-Study of chemical equilibria, chemical potential, and real gases.

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

Course content:

Chapter I: Review of thermodynamics (2 weeks)
I.1 Mathematical review of partial derivatives
I.2 State variables and functions
I.3 Thermodynamic quantities and systems
I.4 The different principles of thermodynamics
I.5 Criteria for system evolution and chemical potential

Chapter II: Thermodynamic properties of pure substances (4 weeks)
II.1 Ideal gases
II.2 Intermolecular forces and the actual behavior of gases
II.3 Equations of state for real gases
II.4 Corresponding states, residual deviations, and fugacity
II.5 Thermodynamic properties of condensed states

Chapter III: Phase equilibria of a pure substance (4 weeks)
II.1 General equilibrium relations (Clapeyron and Clapeyron-Clausius)
II.2 Liquid-vapor, liquid-solid, and solid-vapor equilibria
II.3 Stable and unstable equilibria and phase transition
II.4 Generalized diagrams

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

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

References

Smith, E.B, Basic Chemical Thermodynamics, second ed., Clarendon Press, Oxford, 1977.
Rossini, F. D., Chemical Thermodynamics, Wiley, New York, 1950. Florence,

Stanley I.Sandler,Chemical and Engineering Thermodynamics, Wiley, New York, 1977.
Elliot,J, Lira C.T, Introductory chemical engineering Thermodynamics , Prentice –Hall (1999)
Lewis G.N., Randal M., Thermodynamics, Mac Graw Hill
Hougen O.A., Watson K.M., Chemical process principles, Vol II: thermodynamics John Wiley and sons

Semester: 4
Teaching unit: UEF 2.2.3
Subject 1: Chemical kinetics
SH: 22h30 (Lecture: 1h30 ; 1h30 Tutorial)
Credits: 4
Coefficient: 2

Course objectives:
To provide students with the essential foundations for any kinetic study of a chemical process, covering both the basic concepts of formal kinetics and the mathematical foundations relating to the concept of chemical reaction rate and its evolution over time, the parameters influencing reaction rate, the determination of reaction order using physicochemical methods, the rate constant, and activation energy.

Recommended prior knowledge:
Mathematics (derivatives, integrals), ability to express the concentration of a solution, mastery of unit systems, ability to plot and interpret graphs.

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

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

Chapter III. Formal kinetics, simple reaction (6 weeks)
I. Determination of the rate constant of a reaction of o

Chapter III. Formal kinetics, simple reaction (6 weeks)
I. Determination of the rate constant of a reaction of a given order (order 0, 1, 2, 3, and n)
II. Determination of reaction orders
-Methods for determining order by integration (variation in concentrations as a function of time, partial reaction time methods), calculation example
- Differential method, calculation example
- Methods based on order degeneration, calculation example
- Method using dimensionless parameters, calculation example

Chapter IV. Compound reactions (6 weeks)
1. Opposing or balanced reactions
-General information
- Examples of opposing reactions (both opposing reactions are first-order, second-order, second-order reactions opposed to first-order reactions, first-order reactions opposed to second-order reactions)
-Equilibrium and reaction rates
-Principle of microreversibility
2. Parallel reactions: general information, twin reactions, competing reactions, example,

3. Successive reactions: determination of rate constants, radioactive equilibrium, calculation example.

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

Reference:

1-ClaudeMoreau,Jean-PaulPayen,Cinétiquechimique,EditionBelin1999

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

3-P.Morlaes,Cinétiquechimique:Structuredelamatière1978

4-B.Frémaux,Élémentsdecinétiqueetdecatalyse,EditeurTecet1998

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

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

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

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

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

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

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

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

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

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

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

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

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

Semester :4
Teaching unit :UEM 2.2
Subject 2: Numerical methods
SH: 67h30 (Lecture: 1h30, Tutorial: 1h30 ; 1h30 Practical Work)
Credits : 5
Coefficient: 3

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

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

Course content:

Chapter 1. Solving nonlinear equations f(x)=0 (3 weeks)
1. Introduction to calculation errors and approximations, 2. Introduction to methods for solving nonlinear equations, 3. Bisection method, 4. Successive approximation method (fixed point), 5. Newton-Raphson method.

Chapter 2. Polynomial interpolation (2 weeks)
1. General introduction, 2. Lagrange polynomial, 3. Newton polynomials.

Chapter 3. Function approximation: (2 weeks)
1. Approximation method and quadratic mean. 2. Orthogonal or pseudo-orthogonal systems. Approximation by orthogonal polynomials, 3. Trigonometric approximation.

Chapter 4. Numerical integration (2 weeks)
1. General introduction, 2. Trapezoidal method, 3. Simpson's method, 4. Quadrature formulas.

Chapter 5. Solving ordinary differential equations
(Initial value problem or Cauchy problem) (2 weeks)
1. General introduction, 2. Euler's method, 3. Improved Euler's method, 4. Runge-Kutta method.

Chapter 6. Direct methods for solving systems of linear equations (2 weeks)
1. Introduction and definitions, 2. Gauss method and pivoting, 3. LU factorization method, 4. Cholesky factorization method, 5. Thomas algorithm (TDMA) for triangular systems.

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

Practical work:
Programming different numerical methods for use in mathematical calculations using a scientific programming language (Matlab, Scilab, etc.).

1. Solving nonlinear equations: 1. Bisection method. 2. Fixed point method, 3. Newton-Raphson method
2. Interpolation and approximation: 1. Newton's interpolation, 2. Chebyshev approximation

3. Numerical integration: 1. Rectangle method, 2. Trapezoidal method, 3. Simpson's method
4. Differential equations: 1. Euler's method, 2. Runge-Kutta methods
5. Systems of linear equations: 1. Gauss-Jordan method, 2. Crout decomposition and LU factorization, 3. Jacobi method, 4. Gauss-Seidel method

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

Bibliographic references

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

Semester: 5
Teaching unit: UEM 2.2
Subject: Instrumentation – Sensors
SH: 45h00 (Lecture: 1h30, Tutorial: 1h30)
Credits: 4
Coefficient : 2

Teaching objectives:
Acquire the knowledge necessary to master and exploit the physical effects involved in instrumental devices for collecting information in the measurement environment: machines, environment, etc.

Recommended prior knowledge:
Thermodynamics; Fluid mechanics; Transfer phenomena.

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

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

Chapter 3: (2 weeks)
Flow measurements: Differential pressure, orifice, and variable area flow meters; Meters.

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

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

Chapter 6: (5 weeks)
Sensors: Sensor physics: Simple sensors; Transduction functions; Energy and electrical aspects; Multiple transduction sensor devices: Test body, Active quantity and measured quantity; Conditioning circuits: Differential bridges, integrated conditioners, compensation for offsets and drifts; Applications to thermal, mechanical, and electromagnetic measurements and to the measurement of chemical species.

Assessment method:
Exam: 60%, continuous assessment: 40%

Bibliographical references:

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

Semester: 4
Teaching unit: UEM 2.2
Subject 1: Practical work on solution chemistry and chemical kinetics
Total hours: 22.5 hours (practical work: 1.5 hours)
Credits: 2
Coefficient : 1

Teaching objectives:
Understand and assimilate knowledge.

Recommended prior knowledge
Basic concepts of general chemistry and thermodynamics. Students should already be familiar with laboratory equipment and glassware.

Course content:

Practical work on solution chemistry:
Practical work No. 1. Determining water hardness using complexometry.
Practical work No. 2. Experimental verification of Nernst's law.
Practical work No. 3. Conductometric titration of vinegar.
Practical No. 4. pH-meter-assisted titration of the alkalinity of an aqueous solution using a hydrochloric acid solution. Gran's method.
Practical No. 5. pH-meter- and conductometric-assisted titration of a sodium hydroxide solution.
Practical work No. 6. Investigation of first group cations.
Practical work No. 7. Determination of the solubility product of a poorly soluble salt.
Practical work No. 8. Measurement of the formation constant of a complex.
Practical work No. 9. Potential-pH diagram of iron.

Kinetics Practical work:
- Chemical method (followed by volumetric method):
- Saponification of an ester (ethyl ethanoate by sodium hydroxide):
RCOOR' + NaOH = RCOONa + R'OH
- Physical method
- Polarimetry: kinetics of sucrose inversion.
- Spectrophotometry: Decomposition of a Mn3+ complex
- Conductometric method: Saponification of an ester (ethyl ethanoate by sodium hydroxide)
- Volume measurement: Decomposition of oxygenated water (hydrogen peroxide

Assessment method:
Continuous assessment: 100%.

Reference:

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

Semester: 4
Teaching unit: UET 2.2
Subject 1: ICT
SH: 45 hours (Lecture: 1.5 hours & Workshop: 1.5 hours)
Credits: 2
Coefficient: 2

Teaching objectives:
This course aims to develop the cross-disciplinary skills students need to communicate scientific knowledge. It focuses on mastering documentary research and the use of digital tools (ICT) to collect and organize information, writing clear and well-structured scientific documents (introduction, methodology, results, discussion according to the IMRaD format), give convincing oral presentations tailored to the audience, and adhere to the rules of ethics and integrity (in particular intellectual integrity when citing sources). The course emphasizes clarity and conciseness in scientific writing—writing must be "precise, clear, concise"—as well as ethical communication (avoiding plagiarism, citing sources correctly, etc.).

Prerequisites:
Students must have a high school diploma in science or equivalent, with a good command of written and spoken French. Basic computer skills are recommended (word processing, Internet browsing, email).

Course content:
Chapter 1: Introduction to scientific communication 1 week
Presentation of the course, issues in scientific communication (written and oral), examples of media (articles, reports, presentations). Raising awareness of the importance of integrity and ethics in academic work.

Chapter 2: Documentary research and ICT 1 week
Introduction to online information searching: search engines, academic databases (Google Scholar, Persee, digital libraries). Use of Boolean operators (AND, OR, EXCEPT) to refine searches. Presentation of basic digital skills (word processing, spreadsheets, presentation software).

Chapter 3: Referencing and bibliography 1 week
Principles of citation and bibliographic standards (APA, IEEE, and other formats). Anti-plagiarism rules: how to cite and paraphrase correctly. The importance of carefully noting all bibliographic elements. Introduction to reference management software (Zotero, Mendeley).

Chapter 4: Structure of a scientific document 1 week
Presentation of the standard structure of an article or report (IMRaD format): role of each section (introduction, methodology, results, discussion, conclusion). Importance of a clear and informative title. Discussion of the general logic of the document (problem statement, hypotheses).

Chapter 5: Writing the scientific document 3 weeks
Writing the introduction and abstract:

How to write an effective introduction: presenting the context, formulating the research question and objectives. Writing an informative abstract: structure (context, objective, methods, results, conclusion) and keywords. Techniques for grabbing the reader's attention from the outset.
Writing the methodology and results:
Writing tips for the methodology section (precise description of procedures, materials, conditions) and results (clear presentation of data, use of tables/figures). Distinction between facts (results) and interpretation (discussion). Rules for clarity: simple sentences, active voice/precise verbs.
Discussion, conclusion, and style:
Writing the discussion (putting the results into perspective, comparing them to other work) and formulating a concise conclusion. Rules of style in scientific writing: clarity, conciseness, and precision of language, managing consistency and cohesion (logical connectors) . Common mistakes to avoid.

Chapter 6: Introduction to oral presentations and public speaking techniques 2 weeks
Oral presentation methodology: prepare an outline (introduction, development, conclusion), define your objective, and know your audience. Importance of an engaging introduction (hook) and a summary conclusion.
Public speaking techniques:
Body language and vocal techniques to capture attention: posture, gestures, eye contact, variations in tone and rhythm. Managing stress and stage fright. Best practices: do not read your notes word for word; use only keywords to avoid putting your audience to sleep. Use of aids (paper, slides).

Chapter 7: Visual aids and ICT for presentations 1 week
Use of computer tools (PowerPoint, Beamer, etc.) to create slides. Basic principles: clear and concise slides (KISS), use of relevant diagrams/images, appropriate fonts and colors. Do not overload the slides. Demonstration of screen capture or editing software for scientific content research (Zotero, databases, Google Drive).
Chapter 8: Professional writing 1 week
Written communication techniques outside of articles: writing academic emails (clear subject lines, polite phrases), meeting minutes, project summaries. Concepts of formal style (objectivity, impersonality). Spelling and grammar – review of common errors (agreement, conjugation, word confusion).

Chapter 9: Interpersonal Communication and Listening 1 week
Group communication dynamics: active listening, argumentation, rephrasing. The role of oral communication in teamwork. Techniques for presenting and defending ideas in a debate or small group.

Chapter 10: Academic ethics and integrity 1 week
Principles of academic ethics: integrity, intellectual honesty, respect for results and people. Examples of breaches (plagiarism, fabrication of data, plagiarism). Presentation of national university charters and regulations (obligations and sanctions). Emphasize the importance of “intellectual integrity” in research.

Chapter 11: Scientific standards and practices 1 week

Summary of international publication standards (peer-reviewed journals, impact factor, peer review). Standard formats (APA, etc.) seen earlier. Rules for presenting exams and reports (margins, font, pagination). Introduction to writing a mini-project or internship report.

Workshops:

Workshop: Note-taking exercise using a short video or scientific text; sharing effective note-taking techniques (active listening, keywords, organization).

WORKSHOP 2: Bibliographic research workshop: finding 5 relevant references on a given topic, downloading them or extracting their abstracts; critical evaluation of the reliability of sources (evaluator, date, content).

WORKSHOP 3: Citation exercise: identifying and formatting references in a given text. Creating a bibliography according to a given style.

WORKSHOP 4: Writing a detailed outline (IMRaD) for a given research topic (e.g., a simple scientific problem), identifying the key ideas in each section.

WORKSHOP 5:

- Writing a 150-200 word summary based on a scientific article or short presentation provided. Exercises in rephrasing arguments for the introduction.
- Writing exercise: briefly describe a simple method or experiment based on a given protocol. Create tables or graphs from simulated data.
- Revision workshop: using a deliberately confusing scientific paragraph, rework the wording to make it clearer and more concise. Correction of long or convoluted sentences.

WORKSHOP: 6

- Presentation preparation exercise: each student prepares a mini oral outline on a simple topic in a few minutes, then presents it briefly. Feedback on argumentation and structure.
- Short individual oral presentations on a familiar topic, with optional video recording. Self-assessment and group feedback on voice and body language.

WORKSHOP 7: Creation of a short slideshow (3–5 slides) on a simple scientific topic. Discussion on visual effectiveness.

WORKSHOP 8: Writing a professional email to a professor or supervisor (request for information, project submission). Collaborative correction of a text to eliminate common mistakes.

WORKSHOP 9: Role-play: structured debate on a scientific topic (with turn-taking), or peer feedback on a mini-presentation.

WORKSHOP 10: Formatting a standard document in Word or LaTeX (cover page, table of contents, chapters, bibliography).

Assessment method: Exam 60% and CC PW: 40%

Bibliographic references:

1. D. Lindsay & P. Poindron (2011), Guide de rédaction scientifique : L'hypothèse, clé de voûte de l'article scientifique, Éditions Quae, Versailles.
2. J.E. Harmon & A.G. Gross (2010), The Craft of Scientific Communication, University of Chicago Press.
3. Ministère de l'Enseignement Supérieur et de la Recherche Scientifique (Algérie), Charte d'éthique et de déontologie universitaires, 2010 (voir notamment l'accent sur l'intégrité académique), https://www.mesrs.dz/index.php/fr/ethique-et-deontologie/charte-ethique-et-deontologie/.
4. Baril. D (2008), Techniques de l'expression écrite et orale, Sirey .
5. Jean-Denis Commeignes (2013), 12 méthodes de communications écrites et orale – 4éme édition, Michelle Fayet et Dunod.
6. Cardon, D. (2019). *Culture numérique*, Paris, Presses de Sciences Po
7. Frédéric Wauters (2023). Rédiger efficacement à l'ère du digital Techniques de communication écrite, 2e édition - ISBN 978-2-8073-3772-5.
8. Chartier, M. (2013). Le guide du référencement web. First.

9. Duarte, N. (2019). *DataStory: Explain Data and Inspire Action Through Story* Story Paperback. Ideapress Publishing. ISBN-10 : 1940858984
10. Levan, S. K. (2000). *Le projet Workflow* Concepts et outils au service des organisations. Eyrolles.
11. Anderson, C. (2016). *TED Talks: The Official TED Guide to Public Speaking* (1st edition). Houghton Mifflin Harcourt.
12. Reynolds, G. (2009). *Présentation Zen : Pour des présentations plus simples, claires et percutantes* . Pearson.
13. Thierry , L. (2014). Introduction à la communication - 2ème. Dunod.
14. Serres, A. (2021). *Dans le labyrinthe : Évaluer l'information sur internet*. C&F Éditions.

Semester 5
Teaching unit: UEF 3.1.1
Subject 1: Heat Transfer
Total hours: 45 (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient : 2

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

Recommended prior knowledge:
Thermodynamics, differential equations.

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

Chapter 2: (6 weeks)
Heat transfer by conduction: Fourier's law Cases: single wall, composite walls, cylindrical layer, composite cylindrical layers (electrical analogy, overall resistance); Insulation of cylindrical layers (critical insulation thickness); Insulation of spherical layers. General conduction equation, fin problems,

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

Chapter 4: (3 weeks)
Heat transfer by radiation: Laws of radiation; Lambert's law; Kirchhoff's law; Black body radiation; Non-black body radiation; Reciprocal radiation of several surfaces (heat exchange by radiation between black and gray surfaces).

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

Bibliographical references:

1. J. Krabol, « Transfert de chaleur », Masson, 1990.
2. Martin Becker, “Heat transfer: a modern approach”. Plenum, 1986.
3. J.F. Sacadura, « Initiation au transfert thermique », TEC-DOC, 1980.
4. Pierre Wuithier, « Le pétrole, raffinage et génie chimique ».
5. Y. Jannot, cours de transfert thermique, 2ème édition, école des mines Nancy.

6. Incorpera, Dewwitt, Bergmann, Lavine, « Fundamentals of heat and mass transfer » , 6th edition Ed. Wiley (2010)

Semester: 5
Teaching unit: UEF 3.1.1
Subject 2: Material Transfer
SH: 45 hours (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient : 2

Teaching objectives:
Understand the mechanisms and formalism used to describe mass transfer; Know how to write a mass balance required for equipment calculations.

Recommended prior knowledge:
Thermodynamics; Chemical kinetics; Differential equations.
Course content:
Chapter 1: Mechanisms of mass transfer (3 weeks)
Introduction; Definition of molecular diffusion; Nomenclature: mass and molar concentrations, total and individual, diffusion and transport flux densities (convection + diffusion); Definition of average mass and molar velocities; Fick's law and Stefan Maxwell's law (multicomponent gaseous systems);
Diffusion coefficients (gas phase, liquid phase, order of magnitude of diffusion coefficients in different media (gases, liquids, solids); Diffusion coefficients in porous solids; Concept of effective diffusion coefficients.

-Chapter 2: Stationary and quasi-stationary one-dimensional diffusion (3 weeks)
Mass balance-Continuity equation (global and partial); Review of gradient operators and divergence of a vector; Total mass balances and balances for a constituent i over a fixed volume element; Boundary conditions and initial conditions; Examples of diffusion problems with a single variable (case of a gas through a stagnant gas film, evaporation problem, equimolar diffusion, applications for different geometries (plane, cylinder, sphere)); Diffusive transfer with homogeneous and heterogeneous chemical reaction.

Chapter 3: Transient diffusive transfer: (5 weeks)
Transient diffusive transfer: Fick's second law; Problems with instantaneous sources (limited amount of diffusing material); Problems with continuous sources (fixed boundary conditions (learning to pose a problem with its appropriate equation and initial and boundary conditions).

-Chapter 4: Mass transfer at an interface (between phases) (4 weeks)
Review of equilibria between two phases; Two-film theory, penetration theory, surface renewal theory; Individual and overall mass transfer coefficients; Concept of dimensional analysis: Buckingham's π theorem; Dimensionless numbers related to mass transfer (Sherwood, Reynolds, Schmidt); Estimates of mass transfer coefficients (dimensionless correlations)

Assessment method:

Continuous assessment: 40%; Exam: 60%.

Bibliographical references:

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

Semester 5
Teaching unit: UEF 3.1.1
Subject 3: Transfer of Momentum
SH: 45 hours (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient : 2

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

Recommended prior knowledge:
Basic mathematics; Notions of MDF.

Course content:
Chapter 1: (2 weeks)
Review: A- Properties of fluids, Fluid statics, Dynamics of ideal fluids.

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

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

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

Chapter 5: (3 weeks)
Pumps and pumping: Network calculations.

Assessment method:
Exam: 100%.

Bibliographical references:

1. Laszlo, « Les bases scientifiques du génie chimique », Dunod, 1972.
2. Robert E Treybal, "Mass tranfer operation ».Mc Graw-Hill, 1981.
3. R. B. Bird, W. E. Stewart, and E. N. Lightfoot,« Transport Phenomena », Wiley 1960.
4. Midoux Noel, Mécanique des fluides en genie chimique, Coll. Génie des procédés de l'école de Nancy.

5. R. Comolet, Mécanique des fluides réels - Tome 2, *Ed. Dunod, 2006*.
6. M. Fourar, Equations générales, solides élastiques, fluides, turbomachines, similitude, *Ed. Ellipses, 2ème Edition 2015*.

Semester: 5
Teaching unit: UEF 3.1.2
Subject 1: Electrochemistry
Total hours: 45 (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient : 2

Course objectives:
Acquire the basic concepts of electrochemistry, thermodynamics, and electrochemical kinetics necessary for understanding electrochemical phenomena.

Recommended prior knowledge:
Chemistry of solutions. Chemical thermodynamics and concepts of kinetics.

Course content:
Chapter 1: (1 week)
Review of electrolytic solutions: Conductivity, ion mobility, Oswald's dilution law, Kohlrausch's law.

Chapter 2: (3 weeks)
Properties and physical quantities of electrolytes: Debye-Huckel theory: applications to activity coefficient calculations; ion solvation and hydration; Faraday's laws (deviations and yields).

Chapter 3: (5 weeks)
Thermodynamics of electrochemical reactions: Definition and preliminary reminders; Concepts of chemical potential; Electrode voltage and equilibrium potential; Concepts of electrochemical double layer and Stern model; Nernst equation and its applications; Prediction of RedOx reactions; Different types of electrodes; Electrochemical cells and concepts of junction voltage (Henderson's law).

Chapter 4: (4 weeks)
Kinetics of electrochemical reactions: Definitions; Speed of an electrochemical reaction; Electrochemical setups, Butler-Vollmer's law; Tafel approximation.

Chapter 5: (2 weeks)
Electrochemical methods and techniques: Voltammetry; Chronopotentiometry, etc.

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

Bibliographical references:

1. Genévrière ML Dumas, Roger Benaîm, l'indispensable en électrochimie, Breal, 2001.
2. G. Milazo, « Electrochimie », Dunod,1969.
3. Brenet, « Introduction à l'électrochimie de l'équilibre et du non équilibre », Masson,1980.

4. Allen J. Bard, « Electrochimie : principes, méthodes et applications », Masson, 1983.
5. Fabien Miomandre, SaïdSadki, PierreAudebert, « Electrochimie des concepts aux applications », Dunod, 2005.
6. F.Cœuret, A. Stock,« Eléments de génie électrochimique », Lavoisier Tech. &.Doc, 1993.

Semester: 5
Teaching unit: UEF 3.1.2
Subject 3: Chemical kinetics and homogeneous catalysis
Total hours: 45 (Lectures: 1.5 hours, tutorials: 1.5 hours)
Credits: 4
Coefficient : 2

Teaching objectives:
Consolidate basic concepts of chemical kinetics (kinetic law: order, activation energy, rate constant). Acquire concepts for approaching reaction mechanisms. Introduce an important branch of chemical kinetics in various sectors: catalysis.

Recommended prior knowledge:
The basics of general chemistry (atomistics, chemical bonding, thermochemistry) and the fundamental concepts of chemical kinetics.

Course content:
Chapter 1: (2 weeks)
Review: Simple laws of chemical reaction rates; activation energy; molecularity.

Chapter 2: (4 weeks)
Reaction mechanisms: quasi-steady state approximation; step mechanisms; chain mechanisms.

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

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

Assessment method:
Exam: 100%.

Bibliographical references:

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

Semester: 5
Teaching unit: UEM 3.1
Subject 1: Analysis techniques
SH: 37.5 hours (Lectures: 1.5 hours, Practical work: 1 hour)
Credits: 3
Coefficient : 2

Course objectives:
Learn about the main physical analysis methods: principles, benefits, and scope of application, particularly in the field of process engineering. Acquire the basics of analyzing and testing raw materials and formulated products.

Recommended prior knowledge:
Basic concepts of wave-particle duality; chemical bonds; electronic transitions; concepts of analytical chemistry; solution chemistry.

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

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

Chapter 3: (4 weeks)
Infrared (IR) spectroscopy: Principle; Theoretical concepts; Equipment; Interpretation of an IR absorption spectrum.

Applications:
- Identification and quantification by HPLC and GC-MS
- Verification of Beer-Lambert's law
- Identification of organic functions by IR.

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

Bibliographic references:

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

Semester: 5
Teaching unit: UEM 3.1
Subject 2: Practical work in Physical Chemistry 1 and Chemical Engineering 1.
SH: 22:30 (Practical work: 1:30)
Credits: 2
Coefficient : 1

Teaching objectives:
Observation of physical phenomena studied during lectures; Validate and correctly present the results obtained; Formulate and understand an experimental technique; Validate and correctly present the results obtained; and communicate conclusions.

Recommended prior knowledge:
- Chemistry of solutions, concepts of kinetics, basics of thermodynamics.
- Be familiar with laboratory safety instructions and be willing to work in a group.
Basics of thermodynamics, concepts of transfer phenomena.

NB: This list is for guidance only and should be adapted according to resources;
Number of practical sessions to be completed = Seven (7): 4 in electrochemistry; 3 in homogeneous catalysis. 3 in heat transfer; 2 in mass transfer; 2 in TQM.

Course content:
Electrochemistry practical
- **Dissociation constant; weak electrolytes; activity coefficient.**
- **Construction of an electrochemical cell.**
- **Plotting of current-potential curves.**
- **Measurements of cell voltage as a function of temperature and error calculations.**
- **Corrosion of a metal.**
- **Electrolysis practical**
-

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

Chemical engineering lab 1:
- **Measurement of the transfer coefficient, KLa, in a mechanically stirred reactor.**
- **Diffusion of liquids.**
- **Study of heat transfer by axial and radial conduction.**

- **Study of heat transfer by convection.**
- **Study of heat transfer by radiation.**
- **Measurement of linear pressure losses in pipes of different diameters.**
- **Measurement of the friction coefficient in smooth pipes.**
- **Calibration of a measuring device.**
- **Study of the performance of a measuring sensor (class, accuracy, precision, speed, etc.).**

Assessment method: Continuous assessment: 100%.

Bibliographical references:

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

Semester: 5
Teaching unit: UEM 3.1
Subject 3: Macroscopic balances
SH: 37.5 hours (Lectures: 1.5 hours, tutorials: 1.5 hours)
Credits: 3
Coefficient : 2

Course objectives:
The various operations involved in process engineering require the preparation of material and energy balances in order to understand how equipment works and how it is sized. The objectives of this course are to provide all the fundamental concepts needed to prepare material and energy balances for a process in order to model processes.

Recommended prior knowledge:
Physical chemistry, transfer phenomena, basic mathematics and computer science.

Course content:
- **Fundamental concepts – black box analysis**
- **Processes with or without chemical reactions**
- **Determining degrees of freedom**
- **Diagram with recycling**
- **Diagram with recycling and purging**
- **Illustrative examples (continuous reactor; separation column; heat exchanger; cooling tower; boiler, etc.)**

Assessment method:
Continuous assessment: 40%, exam: 60%.

Bibliographic references:

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

Semester: 5
Teaching unit: UED 3.1
Subject 1: Pharmaceutical and agri-food processes
Total hours: 22.5 (Lectures: 1.5 hours)
Credits: 1
Coefficient : 1

Teaching objectives:
Provide a descriptive introduction to the basic concepts of synthesis processes, the treatment and purification of therapeutic molecules, their formulation in galenic preparations, including the processes involved, namely: processes and technologies related to the formulation and industrial production of drugs.

Recommended prior knowledge:
Basic chemistry; concepts of chemical engineering.
Course content:
Part 1: Pharmaceutical processes
Chapter 1: Medicines
- **Introduction**
- **Definitions**
- **The stages of drug development**
- **Different classifications of drugs**
- **Active ingredients**
- **Excipients**
- **Packaging**
- **Drug activity and toxicity**
- **What happens to active ingredients in the body**

Chapter 2: Synthesis operations
- **Sources of active ingredients**
- **Methods of obtaining natural substances**
- **Synthetic methods**
- **Biotechnological methods**

Chapter 3: Preformulation
- **Routes of administration**
- **Choice of dosage forms**
- **Biopharmaceutical classification (solubility, permeability)**
- **Dissociation coefficient, partition coefficient**

Chapter 4: Manufacturing environment
- **Pharmaceutical companies**
- **Manufacturing pharmaceutical water**
- **Air treatment**
- **The concept of quality in the pharmaceutical industry**

Part 2: Food processing

Chapter 1:

Processing and preservation methods: Optimization of thermal processes: Pasteurization; Appertization; Cooking; Aseptic processes; Optimization of refrigeration processes, Refrigeration; Deep-freezing; Refrigerated transport; Dehydration and combined processes: Drying; Smoking; Dehydration-impregnation by immersion (DII).

Chapter 2:

General information on separation processes: Phase separation: Pressing; Decantation, Filtration; Centrifugation; Molecular-scale separation: Extraction; Distillation, Evaporation, Entrainment...; Membrane processes.

Chapter 3:

Reaction engineering: Physicochemical reaction engineering: Coagulation, Gelation, Formation of mixed networks, Thermo-induced reactions; Biological reaction engineering: Biomass production, Metabolite production, Fermentation, Bioconversion.

Chapter 4:

Structuring operations; Emulsification; Cooking-extrusion; Whipping.

Chapter 5:

Mechanical and manufacturing operations: Grinding; Sieving; Flow (particularly of powders); Transfer; Cutting; Assembly and shaping; Packaging and packing.

Assessment method: Exam: 100%.

Bibliographical referencesRéférences bibliographiques:

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

Semester: 5
Teaching unit: UED 3.1
Subject 2: Air, Water, and Soil Pollution
SH: 22:30 (Class: 1:30)
Credits: 1
Coefficient : 1

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

Recommended prior knowledge:
Basic knowledge of chemistry.
Course content:
Chapter 1: (5 weeks)
Water Pollution: Water cycle; Water quality measurement; Sources, mechanisms, and symptoms of pollution in running water and lakes; Influence of pollution on living beings; Oxygenation and deoxygenation; Eutrophication; Concepts of wastewater treatment and purification; Prevention of water pollution.

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

Chapter 3: (5 weeks)
Air Pollution: Context: Environment-Pollution-Sustainable Development-Energy-Primary Energy Consumption and CO2 Emissions; Findings; Fundamental Concepts of the Atmosphere and Meteorological Parameters; Changes in Air Quality and Effects on Organisms; Chemical components of atmospheric air; Chemical pollutants; NO2 pollution; Formation of pollutants; Some consequences of air pollution: Greenhouse effect; Photochemical smog; Ozone hole.

Assessment method: Exam: 100%.

Bibliographic references:

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

Semester: 6
Teaching unit: UEF 3.2.1
Subject 1: Unit operations
Total hours: 67.5 (Lectures: 3 hours, Tutorials: 1.5 hours)
Credits: 6
Coefficient : 3

Teaching objectives:
To learn about the main unit operations and understand the process diagrams of the various process engineering industries (chemical, electrochemical, agri-food, pharmaceutical, etc.); to write and check the material balances for these processes.

Recommended prior knowledge:
Thermodynamics; Differential equations; Transfer phenomena.

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

Chapter 2: (3 weeks)
Absorption: Liquid-gas equilibrium; Isothermal absorption, Material balances; Concept of theoretical stage; Mac Cabe and Thièle method, concepts of contactors (packed and tray columns), hydrodynamics of flows

Chapter 3: (4 weeks)
Liquid-liquid extraction: Introduction; definitions (solvent, solute, diluent), equilibrium diagram; single-stage extraction; multistage extraction: MacCabe and Thièle graphical method, number of theoretical plates

Chapter 4: (3 weeks)
Liquid-Solid Extraction (Leaching): Solid-Liquid Equilibrium; Janeck Diagram: Determination of the Number of Theoretical Stages, Countercurrent and Cross-Current Extraction.

Chapter 5: (4 weeks)
Distillation: Distillation of a binary mixture; Batch and continuous distillation; Calculation of the efficiency of a rectification column (graphical methods of MacCabe and Thièle and Ponchon and Savarit).

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

Bibliographical references:

1. Robert E. Treybal,«Mass transfer operations», MC Graw Hill.
2. MC Cabe et Smith,« Chemical engineering operations», MC Graw Hill.

3. 3. COULSON J.M., J.F RICHARDSON, J.R BACKHURST and J.H. HARKER, "Chemical Engineering", volume two, Fifth edition, 2002.

Semester: 6
Teaching unit: UEF 3.2.1
Subject 2: Thermodynamics of Equilibria
Total hours: 45 (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient : 2

Teaching objectives:
Master the application of the three principles of thermodynamics; Distinguish between the different states of a gas; Predict the direction of a chemical reaction.

Recommended prior knowledge:
Chemical thermodynamics; Differential equations.

Course content:
Chapter 1: Thermodynamics of solutions (2 weeks)
I.1 Behavior of a constituent in a mixture; I.2 Partial molar quantities; I.3 Excess quantities and activity; I.4 Models of non-electrolyte liquid solutions; I.5 Real gas mixtures and pseudo-critical properties

Chapter 2: Liquid-vapor equilibrium (5 weeks)
II.1 Equilibrium of an ideal binary mixture; II.2 Equilibrium of arbitrary solutions with miscible and immiscible constituents; II.3 Liquid-vapor diagram at constant pressure and temperature; II.4 Application to fractional distillation and vapor entrainment; II.5 Extension to ternary systems

Chapter 3: Thermodynamics of liquid-liquid and liquid-solid equilibria (5 weeks)
III.1 Liquid-liquid binary mixtures; III.2 Application to liquid-liquid extraction; III.3 Liquid-solid mixtures; III.4 Activity and solubility diagrams; III.5 Application to ternary mixtures; III.6 Surfaces and interfaces

Chapter 4: Thermodynamics of chemical equilibria (3 weeks)
IV.1 Equilibrium of a system in chemical reaction; IV.2 Homogeneous and heterogeneous chemical reactions; IV.3 Phase equilibria associated with a chemical reaction

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

Bibliographic references:

1. Smith, E.B, Basic, Chemical Thermodynamics, 2nd ed., Clarendon Press, Oxford, 1977.
2. Stanley I.Sandler, Chemical and Engineering Thermodynamics, Wiley, New York, 1977.
3. Lewis G.N., Randal M., Thermodynamics, Mac Graw Hill
4. Hougen O.A., Watson K.M., Chemical process principles, Vol II: Thermodynamics, John Wiley and sons
5. Brodyanski V., Sorin M., Le Goff P. The efficiency of industrial processes, exergy analysis and optimization, Amsterdam, Elsevier, (1994).

6. Wuithier, P, le pétrole, raffinage et génie chimique, édition technip 1972
7. Abbott M; Théorie et applications de la thermodynamique, série schum, Paris 1978
8. Kireev, V. Cours de chimie physique, Edition Mir, Moscou 1975

Semester: 6
Teaching unit: UEF 3.2.2
Subject 1: Homogeneous reactors
SH: 45 hours (Lectures: 1.5 hours, Tutorials: 1.5 hours)
Credits: 4
Coefficient : 2

Teaching objectives:

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

Recommended prior knowledge:

Thermodynamics, basic mathematics; transfer phenomena.

Course content:

Chapter 1: (1 week)

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

Chapter 2: Classification of chemical reactors (1 week)

Classification of chemical reactors: Perfectly stirred batch reactor (PSBR); perfectly stirred continuous reactor (PSCR); perfectly stirred continuous tubular reactor with piston flow (PCTR).

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

Single reaction: Perfectly stirred closed reactor; Perfectly stirred continuous reactor in steady state; Piston reactor in steady state.

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

1-R.D.P.A; R.C.P.A; R.C.P; 2- Combination of chemical reactors: Combination of continuous stationary reactors with piston flow (series/parallel); Combination of perfectly stirred continuous stationary reactors (series/parallel); 3- Comparative performance of ideal reactors.

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

Consecutive irreversible reactions; Competitive reactions. Selectivity and yield;

Chapter 6: Non-isothermal ideal reactors (3 weeks)

Concepts of heat balances in non-isothermal ideal reactors.

Assessment method:

Continuous assessment: 40%, Exam: 60%.

Bibliographical references:

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

Semester: 6
Teaching unit : UEF 3.2.2
Subject 2: Surface phenomena and heterogeneous catalysis
Total hours: 45 (Lectures: 1.5 hours, tutorials: 1.5 hours)
Credits: 4
Coefficient : 2

Teaching objectives:
To introduce the concept of surface tension as an essential parameter in interfacial interactions. Description of the phenomenon of gas adsorption on the surface of solids through the laws of thermodynamics. Application to the determination of the surface area and pore volume of solids.
Provide the basics of heterogeneous catalysis and the various techniques for developing catalysts. Briefly demonstrate the complexity of the catalytic process and the importance of kinetic modeling.

Recommended prior knowledge:
Mathematics; Chemical kinetics; basics of thermodynamics.

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

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

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

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

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

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

Bibliographical references:

1. C. E. Chitour,«Physico-chimie des surfaces », OPU. Volume 1 et 2.
2. J.M. Coulson, J.F. Richardson, Backhurst, Harker,« Chemical engineering », Pergamon Press.
3. J. Fripiat, J. Chaussidon, A. Jelli, « Chimie-physique des phénomènes de surface », Masson.
4. M. Boudart,« Cinétique des réactions en catalyse hétérogène »,Masson.
5. Fauvelle. J.L. (1989). La physico-chimie; son rôle dans les phénomènes naturels, astronomiques, géologiques, et biologiques. Édition : *Reinwald*, 512 p.
6. Friedli, C. (2005). Chimie générale pour ingénieur, Édition : *Presses polytechniques et universitaires romandes*.750p.
7. Fripiat, J. Chaussidon J, Jelli A. (1971) Chimie-physique des phénomènes de surface, Édition : *Masson*, 387 p.
8. Landolt, D. (1993) Corrosion et chimie de surfaces des métaux. Édition : *PPUR presses polytechniques.* 552 p.
9. Lalauze, R. (2006). Physico-chimie des interfaces solide-gaz 1 : concepts et méthodologie pour l'étude des interactions solide-gaz (Coll. Capteurs et instrumentation). Édition *Hermes Science*, 240 p.
10. Somorjai, G.A., Marie-Paule Delplancke, M.P. (1995). Chimie des surfaces et catalyse Édition : *Ediscience International.* 713 p.
11. Peter William Atkins, Julio De Paula, Chimie Physique, Editeur : De Boeck, 4e édition , 2013

12.Sidney F.A. Kettle, Physico-chimie inorganique, Editeur : De Boeck, 4e édition , 2013

13. Moore W.J.Chimie physique .Ed Dunod , 2 éme Edition (1965)

Semester: 6
Teaching unit: UEM 3.2
Subject 1: End-of-Cycle Project
SH: 45 hours (practical work: 3 hours)
Credits: 4
Coefficient : 2

Teaching objectives:
To assimilate knowledge of different subjects in a comprehensive and complementary manner. To put the concepts taught during the course into practice in a concrete way. To encourage a sense of autonomy and initiative in students. To teach them to work in a collaborative environment by stimulating their intellectual curiosity.

Recommended prior knowledge:
The entire Bachelor's degree program.

Course content:
The topic of the End-of-Cycle Project must be chosen jointly by the tutor and the student (or group of students: pairs or trios). The subject matter must be consistent with the objectives of the program and the student's actual abilities (bachelor's degree level). It is also preferable that the topic take into account the social and economic environment of the institution. When the nature of the project requires it, it may be subdivided into several parts.

Note:
During the weeks when students are familiarizing themselves with the purpose of their project and its feasibility (bibliographic research, research into the software or equipment needed to carry out the project, revision and consolidation of teaching directly related to the subject, ...), the subject coordinator must use this face-to-face time to remind students of the essential content of the two subjects "Writing Methodology" and "Presentation Methodology" covered during the first two semesters of the common core.

At the end of this study, students must submit a written report in which they must explain as clearly as possible:
- **A detailed presentation of the study topic, emphasizing its relevance to their socio-economic environment.**
- **The resources used: methodological tools, bibliographic references, contacts with professionals, etc.**
- **An analysis of the results obtained and a comparison with the initial objectives.**
- **A critique of any discrepancies found and the presentation of any additional details.**
- **An identification of the difficulties encountered, highlighting the limitations of the work carried out and the follow-up to be given to the work completed.**

Finally, the student or group of students present their work (in the form of a brief oral presentation or poster) to their tutor and an examiner, who may ask questions and assess the work accomplished from a technical standpoint and in terms of the presentation.

Assessment method: Continuous assessment: 100%

Semester :*5*
Teaching unit: UEM 3.2
Subject 2: Process simulators
SH: 37.5 hours (Lectures: 1.5 hours, practicals: 1.5 hours)
Credits: 3
Coefficient : 2

Course objectives:
- Become familiar with the concepts of process modeling and simulation.
- Learn about the main simulation software programs used in process engineering.
- Learn the basics of equipment and process design using software.

Recommended prior knowledge:
Mathematics. Physical chemistry. Basic understanding of transfer phenomena.

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

Chapter 2: (3 weeks)
Getting started with the chosen software: Creating a simulation; Selecting the list of compounds; Selecting the thermodynamic model; Familiarizing yourself with the simulation sheet; Installing and specifying material flows.

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

Chapter 4: (3 weeks)
Simulation of some equipment: Simulation of pumps; Compressors; Expansion valves; Flash separators; Heat exchangers; Furnaces and reactors.

Chapter 5: (4 weeks)
Examples of process simulation
Assessment method:
Continuous assessment: 40%, Exam: 60%

Bibliographical references:

1. Michael E. Hanyark Jr.,«Chemical Process Simulation and the Aspen HYSYS Software », CreateSpace Independent Publishing Platform, 2012.
2. Hossein Ghanadzadeh Gilani, Katia Ghanadzadeh Samper, Reza Khodaparast Haghi, « Advanced Process Control and Simulation for Chemical Engineers », CRC Press, 2012.

3. Alexandre Dimian, « Integrated Design and Simulation of Chemical Processes », Elsevier, 2003.
4. Amiya K. Jana, « Chemical Process Modeling& Computer Simulation », PHI Learning Pvt. Ltd., 2008.

Semester: 6
Teaching unit: UEM 3.2
Subject 3: Practical work in Physical Chemistry 2 and Chemical Engineering 2
Total hours: 22.5 hours (practical work: 1.5 hours)
Credits: 2
Coefficient: 1

Teaching objectives:
Observation of physical phenomena studied during lectures; Validating and correctly presenting the results obtained; Formulating and communicating conclusions.

Recommended prior knowledge:
Concepts of kinetics, basics of thermodynamics, Be familiar with laboratory safety instructions and be willing to work in a group.

NB: This list is for guidance only and should be adapted as appropriate.
Number of practical to be completed = eight (8): 2 in thermodynamics; 2 in surface chemistry; 4 in chemical engineering.

Course content:
Practical 1. Thermodynamics
-Determination of heat of dissolution.
-Thermodynamic functions of an acid-base equilibrium.
-Heat of vaporization of a pure liquid (Determination of the latent heat of vaporization of acetone.)
-Thermodynamic phase diagrams: Liquid-vapor equilibria. Liquid-liquid equilibria.
-Heat of ionic reaction.
-Determination of partial molar volumes of a binary solution.
-Diagram of a ternary mixture.

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

TP3. Chemical engineering
-Batch distillation.
-Continuous distillation of ethanol/water mixture.
-Simple distillation
-Solvent extraction
-Partition coefficient

Assessment method: Continuous assessment: 100%.

Semester :*6*
Teaching unit: UED 3.2
Subject 1: Cryogenic processes
SH: 22:30 (Class: 1:30)
Credits: 1
Coefficient: 1

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

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

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

Chapter 2: (4 weeks)
Cryogenic fluid separation and purification processes: Separation process: ideal system; Separation processes – Rectification; Role and description of the Joule-Thomson valve; Air separation processes.
Chapter 3: (5 weeks)
Permanent gas liquefaction processes: Linde-Hampson liquefaction process; Linde-Hampson double compression liquefaction process; Claude liquefaction process.

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

Assessment method: Exam: 100%.
Références bibliographiques:

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

Semester :*6*
Teaching unit: UED 3.2
Subject 2: Corrosion
SH: 22:30 (Class: 1:30)
Credits: 1
Coefficient: 1

Objectifs de l'enseignement:

Teaching objectives :

To introduce the phenomenon of corrosion: Provide the theoretical basis and present the various techniques for protecting against corrosion.

Recommended prior knowledge:

The basics of electrochemistry, surface phenomena.

Course content:

Chapter 1: (6 weeks)

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

Chapter 2: (3 weeks)

Phase diagrams: Potential-pH diagram, Applications

Chapter 3: (6 weeks)

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

Assessment method: Exam: 100%.

Bibliographic references:

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

Semester: 6
Teaching unit: UET 2.2
Subject 1: Entrepreneurship & Start-Ups
Total hours: 22.5 hours (Classes: 1.5 hours)
Credits: 1
Coefficient : 1

Course objectives:

This course aims to introduce students to the fundamentals of entrepreneurship, start-up creation, and innovation processes. It will enable students to acquire the skills necessary to identify innovative opportunities, develop a viable business concept, and understand the essential steps involved in creating a start-up.

Course content:

Chapter 1: Introduction to entrepreneurship (2 weeks)

- **Definition and interrelationship between entrepreneurship and innovation**
- **The entrepreneurial and innovation ecosystem in Algeria**
- **Different types of innovation (product, process, business model)**
- **Profile and skills of the innovative entrepreneur**

From idea to project

- **Identifying opportunities**
- **Creativity techniques (brainstorming, mind mapping, etc.)**
- **Case study: failure vs. success**

Chapter 2: Identifying innovative opportunities (1 week)

- **Methods for detecting opportunities for innovation**
- **Analysis of unmet needs in the Algerian market**
- **Design thinking and user-centered approach**
- **Creativity and ideation techniques**

Chapter 3: Business Model Canvas (3 weeks)

- **Components of the Business Model Canvas**
- **Developing the value proposition**
- **Customer segmentation**
- **Distribution channels and customer relations**
- **Cost structure and revenue sources**
- **Developing disruptive business models**

Chapter 4: Introduction to the Business Plan (2 weeks)

- **Structure and key elements of the business plan**
- **Simplified market research**
- **Marketing and sales strategy**
- **Fundamental financial aspects**
- **SWOT analysis**
- **Marketing plan, operational plan**

Chapter 5: Financing start-ups (3 weeks)

- **Sources of financing available in Algeria**
- **Public support mechanisms for entrepreneurship (ANSEJ, incubators, accelerators, CNAC, ANGEM)**
- **Venture capital and business angels**
- **Crowdfunding**

- **Intellectual property protection**
- **Tax benefits and specific support for innovative start-ups**

Chapter 6: Communication and leadership (1 week)

• Oral presentation techniques

• Teamwork, conflict management

Chapter 7: Legal and administrative aspects (1 week)

• Legal forms of companies in Algeria

• Administrative procedures for setting up a business

• Intellectual property protection

- **Taxation of start-ups**

Chapter 8: From concept to completion - Implementing the innovative project (2 weeks)

- **Developing a minimum viable product (MVP)**
- **Testing and validating the innovation on the market**
- **Developing a growth strategy**
- **Effectively presenting an innovative project (pitch)**

Assessment method: 100% exam

Bibliographical references:

1. Christensen, C. M. (2021). **Le dilemme de l'innovateur: Lorsque les nouvelles technologies sont à l'origine de l'échec de grandes entreprises**. VALOR.
2. Nezha D.A. , Mouffok B. (2023). Startups et Entrepreneuriat Le Futur de l'Algérie Éditions universitaires européennes.
3. Osterwalder, A., & Pigneur, Y. (2011). *Business Model Nouvelle Génération : Un guide pour visionnaires, révolutionnaires et challengers*. Pearson.
1. Fayolle, A. (2012). *Entrepreneuriat : Apprendre à entreprendre*. Dunod.
2. Blank, S., & Dorf, B. (2013). *Le Manuel du créateur de start-up : Étape par étape, construisez une entreprise formidable*. Diateino.
3. Ries, E. (2015). *Lean Startup : Adoptez l'innovation continue*. Pearson.
5. Madoui, M. (2015). *Entrepreneurs maghrébins : Terrains en développement*. Karthala.
6. Grim, N. (2012). *Entrepreneurs, Création d'entreprise et Développement*. Éditions universitaires européennes.

IV- Agreements / Conventions

STANDARD LETTER OF INTENT
(In the case of a bachelor's degree co-sponsored by another university institution)
(Official stationery with the letterhead of the university institution concerned)

Subject: Approval of the co-sponsorship of the bachelor's degree

entitled:

The university (or university center) hereby declares that it co-sponsors the above-mentioned bachelor's degree throughout the entire period of the degree's accreditation.
To this end, the university (or university center) will support this project by:
Providing its perspective on the development and updating of teaching programs,
Participating in seminars organized for this purpose,
Participating in defense juries,

Working towards the pooling of human and material resources.

SIGNATURE of the legally authorized person:

POSITION:

Date:

LETTRE D'INTENTION TYPE

(En cas de licence en collaboration avec une entreprise du secteur utilisateur)

(Papier officiel à l'entête de l'entreprise)

OBJET : Approbation du projet de lancement d'une formation de Licence intitulée :

STANDARD LETTER OF INTENT
(In the case of a bachelor's degree in collaboration with a company from the user sector)
(Official stationery with the company's letterhead)

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

Delivered at:
The company hereby declares its willingness to support this training as a potential user of the product.
To this end, we confirm our commitment to this project, and our role will consist of:

- Providing our perspective on the development and updating of teaching programs,
- Participating in seminars organized for this purpose,
- Participating in defense juries,
- Facilitating as much as possible the hosting of interns, either for final graduation theses or for tutored projects.

The necessary resources for the execution of the tasks assigned to us to achieve these objectives will be implemented on both material and human levels.
Mr. (or Mrs.)*……..is designated as the external coordinator of this project.
SIGNATURE of the legally authorized person:
POSITION:
Date:
OFFICIAL STAMP or SEAL OF THE COMPANY

V- Opinions and Visas of Administrative and Advisory Bodies
Bachelor's Degree Title: Process Engineering

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

VI – Opinion and Approval of the Regional Conference

VII – Opinion and Approval of the National Educational Committee for the Field