الجمهورية الجزائرية الديمقراطية الشعبية

People's Democratic Republic of Algeria

وزارة التعليم العالي والبحث العلمي

Ministry of Higher Education and Scientific Research

TRAINING OFFER
L.M.D.

Academic Bachelor's Degree

2025
(3rd update)

Institution	Faculty / Institute	Department

Domain	Field	Specialty
Sciences and Technologies	**Climatic Engineering**	**Climatic Engineering**

Semester organization sheets for specialty teachings

Semester 1

Teaching Unit	Subjects	Credits	Coefficient	Weekly Hourly Volume			Semi-Annual Hourly Volume weeks	Complementary work in Consultation (15 weeks)	Evaluation Method	
	Project name			Lesson	Tuto	XS			Continuous Assessment	Examination
EU Fundamental 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		45 h	55h00	40%	60%
EU Fundamental Code: UEF 1.1 Credits: 12 Coefficients: 6	Mechanical element	6	3	1h30	3h00		67h30	82h30	40%	60%
	Structure of the Material	6	3	1h30	3h00		67h30	82h30	40%	60%
EU Methodology Code: EMU 1.1 Credits: 6 Coefficients: 4	Elements of Soil Mechanics	2	1			1h30	22 h30	22 h 30	100%	
	Structure of the Material	2	1			1h30	22 h 30	22 h 30	100%	
	Structure of computers and applications	2	2	1h30		1h00	37h30	22 h 30	40%	60%
EU Transversale Code: ETU 1.1 Credits: 2 Coefficients: 2	Ethical and deontological dimension (the foundations)	1	1	1h30			22 h 30	2h30 AM		100%
	Occupations in Science and Technology 1	1	1	1h30			22 h 30	2h30		100%
Total Semester 1		**30**	**17**	**9h00**	**12h00**	**4h00**	**375h00**	**375h00**		

Semester 2

Teaching Unit	Subjects	Credits	Coefficient	Weekly Hourly Volume			Semi-Annual Hourly Volume 15 weeks	Complementary work in Consultation (15 weeks)	Evaluation Method	
	Project name			Lesson	Tuto	XS			Continuous Assessment	Examination
EU Fundamental Code: UEF 1.1 Credits: 10 Coefficients: 5	Analysis 2	6	3	1h30	3h00		67h30	82h30	40%	60%
	Algebra 2	4	2	1h30	1h30		45 h	55h00	40%	60%
EU Fundamental Code: UEF 1.1 Credits: 12 Coefficients: 6	Electricity and magnetism	6	3	1h30	3h00		67h30	82h30	40%	60%
	Thermodynamics	6	3	1h30	3h00		67h30	82h30	40%	60%
EU Methodology Code: EMU 1.1 Credits: 6 Coefficients: 4	Electricity and magnetism	2	1			1h30	22 h 30	22 h 30	100%	
	Thermodynamics	2	1			1h30	22 h 30	22 h 30	100%	
	Introduction to Programming	2	2	1h30		1h00	37H30	22 h 30	40%	60%
EU Transversale Code: ETU 1.1 Credits: 2 Coefficients: 2	Free software - open source	2	2	1h30	1h30		45 h	05h00	40%	60%
Total Semester 2		**30**	**17**	**9h00**	**10h30**	**5h30**	**375h00**	**375h00**		

Semester 3

Teaching Unit	Subjects	Credits	Coefficient	Weekly Hourly			Semi-Annual Hourly Volume weeks	Complementary work in Consultation (15 weeks) 15 weeks	Evaluation Method	
	Project name			Lesson	Tuto	XS			Continuous Assessment	Examination
EU Fundamental Code: UEF 1.1 Credits: 10 Coefficients: 5	Analysis 3	6	3	1h30	3h00		67h30	82h30	40%	60%
	Waves and vibrations	4	2	1h30	1h30		45 hrs	45 h	40%	60%
EU Fundamental FEU 2.1.2 Credits:9 Coefficients: 5	Fluid mechanics 1	5	3	1h30	1h30	1h30	67h30	82h30	40% (20%TD+20%TP	60%
	Rational Mechanics	4	2	1h30	1h30		45 h	45 h	40%	60%
EU Methodological Code: MTU 2.1 Credits: 10 Coefficients: 6	Probability and statistics	4	2	1h30	1h30		45 h	45 h	40%	60%
	Python programming	2	2	1h30		1h30	45 h	27h30	40%	60%
	Technical drawing	2	1			1h30	22 h30	27h30	100%	
	Waves and vibrations	2	1			1h00	22 h 30	17h30	100%	
UE Discovery Code: UED 1.1 Credits: 1 Coefficients: 1	Metrology	1	1	1h30			22 h 30	2h30		100%
Total 3rd semester		**30**	**17**	**10h3**	**9h00**	**5h30**	**375h00**	375h00		

Semester 4

Teaching Unit	Subjects	Credits	Coef	Number of hours			Semi-annual hourly volume (15 weeks)	Complementary work in Consultation (15 weeks)	Evaluation Method	
	Project name			**Lesson**	**Tuto**	**XS**			**Continuous Assessment**	**Examination**
EU Fundamental Code: UEF 1.1 Credits: 6 Coefficients: 3	Heating and Air Conditioning	4	2	1h30	1h30		45 h	55h00		60%
	Electricity	2	1	1h30			22 h 30	27h30		100%
EU Fundamental Code: UEF 1.1 Credits: 10 Coefficients: 5	Complex Analysis	4	2	1h30	1h30		45 h	55h00	40%	60%
	Heat Transfer	4	2	1h30	1h30		45 h	55h00	40%	60%
	Notions of Control and Regulation	2	1	1h30			22 h 30	27h30		100%
EU Methodology Code: EMU 1.1 11 Loans Coefficients: 6	Numerical methods	5	3	1h30	1h30	1h30	67h30	82h30	40% (20%TD+20%TP)	60%
	Computer-Aided Design	2	1			1h30	22 h 30	27h30	100%	
	Electricity	2	1			1h30	22 h 30	27h30	100%	
	Heat Transfer	2	1			1h00	15h	10h	40%	
UE Discovery Code: UED 1.1 Credits: 1 Coefficients: 1	Notions of climate architecture.	1	1	1h30			22 h 30	2h30		100%

EU Transversale Code: ETU 1.1 Credits: 2 Coefficients: 2	Techniques information and communication,	2	2	1h30	1h30 workshop		45 h	5h00	40%	60%
Total 4th semester		**30**	**17**	**12h00**	**6h00**	**7h30**	**375h00**	**375h00**		

Semester 5

Teaching Unit	Subjects	Credits	Coef	Number of hours			Semi-Annual Hourly Volume weeks	Complementary work in Consultation (15 weeks)	Evaluation Method	
	Project name			**Lesson**	**Tuto**	**XS**			**Continuous Assessment**	**Examination**
EU Fundamental Code: UEF 1.1 Credits: 10 Coefficients: 5	Applied Thermodynamics	4	2	1h30	1h30		45 hrs	55h00	40%	60%
	Heating facilities	4	2	1h30	1h30		45 h	55h00	40%	60%
	Fluid flow	2	1	1h30			22 h 30	27h30		100%
EU Fundamental Code: UEF 1.1 Credits: 8 Coefficients: 4	Sanitation and Sanitation Facilities	4	2	1h30	1h30		45 h	55h00	40%	60%
	Electrical installations	4	2	1h30	1h30		45 h	55h00	40%	60%
TU Code: MTU 3.1 Credits:9 Coefficients: 5	TP Heating /TP Fluid flow	2	1			1h30	22 h 30	27h30	100%	
	Electrical installations	1	1			1h30	22 h 30	27h30	100%	
	Toilet Facilities	2	1			1h00	15h00	27h30	100%	
	Numerical methods applied (CAD+CFD)	4	2	1h30		1h30	22 h 30	27h30	40%	60%
UE Discovery Code: UED 1.1 Credits: 2 Coefficients: 2	Combustion and gas networks	1	1	1h30			22 h30	2h30		100%
	Renewable energies	1	1	1h30			22 h 30	2h30		100%
EU Transversale Code: ETU 1.1 Credits: 1	ENVIRONMENT AND SUSTAINABILITYT	1	1	1h30			22 h 30	2h30		100%

Coefficients: 1										
Total 5th semester		**30**	**17**	**12h30**	**6h00**	**5h30**	**375h00**	**365h00**		

Semester 6

Teaching Unit	Subjects Project name	Credits	Coef	Weekly Hourly Volume **Lesson**	 **Tuto**	 **XS**	Semi-Annual Hourly Volume weeks	Complementary work in Consultation (15 weeks)	Evaluation Method **Continuous Assessment**	 **Examination**
EU Fundamental Code: UEF 1.1 Credits: 10 Coefficients: 5	installations for conditioning air	6	3	3h00	1h30		67h30	82h30	40%	60%
	Kjøleanlegg	4	2	1h30	1h30		45 h	55h00	40%	60%
EU Fundamental Code: UEF 1.1 Credits: 8 Coefficients: 4	Regulation of	4	2	1h30	1h30		45 h	55h00	40%	60%
	Topography	4	2	1h30	1h30		45 h	55h00	40%	60%
EU Methodology Code: EMU 1.1 Credits:9 Coefficients: 5	End of program project	4	2			2h30	37h30	42h30	100%	
	Practicals in Regulation	2	1			1h30	22 h 30	27h30	100%	
	TP Notions de Topographie	1	1			1h30	22 h 30	27h30	100%	
	TP Air conditioning and cold	2	1			1h30	22 h 30	27h30	100%	
UE Discovery Code: UED 1.1 Credits: 2 Coefficients: 2	Urban Hydraulics	1	1	1h30			22 h 30	2h30		100%
	Acoustics	1	1	1h30			22 h 30	2h30		100%
EU Transversale Code: ETU 1.1 Credits: 1	Entrepreneurship and start-ups	1	1	1h30			22 h 30	2h30		100%

Coefficients: 1										
Total 6th semester		**30**	**17**	**12.**	**6h00**	**7h00**	**375h00**			

III - Detailed programme by subject

Semester: 1
Teaching unit: UEF 1.1.1
Subject 3: Analysis 1
VHS: 67h30 (Course: 1h30, TD: 3h00)
Credits: 6
Coefficient 3

MATERIAL CONTENTS:

Chapter 1: R-Set Properties

1. Part increased, reduced and limited.
2. Maximum item, minimum item.
3. Infimum and supremum
4. Absolute value, integer part.

Chapter 2: Actual Digital Suites

1. Converging suites.
2. Comparison theorems.
3. Monotonous convergence theorem.
4. Suites extracted.
5. Adjacent suites.
6. Particular sequences (arithmetic, geometric, recurring)

Chapter 3: Real Single Variable Functions

1. Business Continuity
2. Derivative and differential of a function
3. Applications to elementary functions (power, exponential, hyperbolic, trigonometric and logarithmic)

Chapter 4: Limited Development

1. Limited development
2. Taylor's formula
3. Limited development of functions

Chapter 5: Simple Integrals

1 Reminders on the Riemann integral and on the calculation of primitives.

Evaluation mode: CC: 40%, Final exam: 60%

Bibliographic references:

1- K. Allab, Elements of analysis, Function of a real variable, 1st& 2nd years of university, Office of University Publications.
2- J. Rivaud, Algebra: Preparatory Classes and University Volume 1, Exercises with Solutions, Vuibert.
3- N. Faddeev, I. Sominski, Upper Algebra Exercise Book, Moscow Edition

Semester: 1
Teaching unit: UEF 1.1.2
Subject 3: Algebra 1
VHS: 45h00 (Class: 1h30, TD: 1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1. Sets, Relationships and Applications (5 weeks)

1. set theory
2. Order relation, Equivalence relations.
3. Injective, surjective, bijective application and reciprocal function: definition of an application, direct image, reciprocal image, characteristic of an application.

Chapter 2: Complex numbers (5 weeks)

1. know the definition of a complex number
2. Representation of a complex number: Algebraic representation, trigonometric representation, geometric representation, exponential representation.
3. Roots of a complex number: square roots, solving the equation: $^2 +$ $:/ = 0$, nth roots of a complex number.

Chapter 3: Vector Space (5 weeks)

1. Vector space, base, dimension (definitions and elementary properties).
2. Linear application, core, image, rank.

Evaluation Method

Final exam / 60%

Bibliographic references:

1. J. Rivaud, Algebra: Preparatory Classes and University Volume 1, Exercises with Solutions, Vuibert.
2. N. Faddeev, I. Sominski, Upper Algebra Exercise Book, Moscow Edition
3. M. Balabne, M. Duflo, M. Frish, D. Guegan, Geometry – 2nd year of the 1st cycle preparatory classes, Vuibert University.
4. B. Calvo, J. Doyen, A. Calvo, F. Boshet, Exercises in algebra, 1st scientific cycle preparation for grandes écoles 2nd grade, Armand Colin – Collection U.

Semester: 1
Teaching unit: UEF 1.1.3
Subject: Element of mechanics:
VHS 67h30 (Course: 1h30, TD: 3h00)
Credits: 6
Coefficient 3

Contents of the Subject: Physics 1 (Mechanics)

Chapter I: Reminder
- Dimensional Analysis.
- Vector calculus

Chapter II: Cinematics
- notion of frame of reference
- Study of movements in space (general case, circular, rectilinear, intrinsic coordinates)
- Coordinate Systems (Cartesian, Polar, Cylindrical, Spherical)
- Relative movement (laws of composition of speeds and accelerations)

Chapter III:
- Inertia principle, inertia mass and Galilean reference frame
- Momentum, conservation of momentum;
- 2. Force in Marriage
- Newton's Laws
- Equation of motion
- Different types of force (gravitation, elastic, viscous,etc.)

Chapter IV: Rotational Movement
- Kinetic moment, Moment of a Force
- Kinetic Moment Theorem and Moment of Inertia
- Applications: torsion, pendulum,etc.

Chapter V: Work, Power, Energy
- Work
- Kinetic energy
- Potential energy (gravitational, elastic,etc.) and states of equilibrium.
- Conservative and non-conservative forces.
- Energy Conservation
- Impulse and shocks (elastic and inelastic)

Evaluation Method
Final exam / 60%

Semester: 1
Teaching unit: UEF 1.1.3
Subject: Structure of the subject
VHS: 67h30 (Course: 1h30, TD:3h00)
Credits: 6
Coefficient: 3

MATERIAL CONTENTS:

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

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

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

Chapter 4: Electronic structure of the atom **(2Weeks)** Wave-corpuscular duality, Interaction between light and matter, Bohr atomic model: hydrogen atom, The hydrogen atom in wave mechanics, Polyelectronic atoms in wave mechanics.

Chapter 5: Periodic Table of the Elements **(3 Weeks)** D. Mendeleiev's Periodic Table, Modern Periodic Table, Evolution and periodicity of physico-chemical properties of the elements, Calculation of radii (atomic and ionic), successive ionization energies, electronic affinity and electronegativity (Mulliken scale) by Slater's rules.

Chapter 6: Chemical Bindings **(3 Weeks)**
The covalent bond in Lewis theory, The polarized covalent bond, dipole moment and partial ionic character of the bond, Molecule geometry: Gillespie theory or VSEPR, Chemical bonding in the quantum model.

Evaluation Method
Continuous monitoring: 40%; Examination: 60%.

References

1. Wow, Devallez, General Chemistry, OPU.
2. S.S. Zumdhal et al., Chimie Générale, De Boeck Université.
3. Y. Jean, Electronic structure of molecules: 1 from atom to simple molecules, 3rd edition, Dunod, 2003.
4. F. Vassaux, La chimie en IUT et BTS.
5. A. Casalot & A. Durupthy, Inorganic Chemistry 2nd Cycle Course, 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.
9. M. Karapetiantz, Constitution de la matière, Ed. --

Semester: 1
Teaching Unit: UEM 1.1.1
Subject: TP Mechanical Element
VHS: 22:30 (TP: 3:00)
Credits: 2
Coefficient 1

Physics practical exercises

- Measurement and calculations of uncertainties
- Freefall
- Inclined plane
- Circular strokes
- pendulum
- Oscillating Clock
- Friction solid-solid

Evaluation Method

Continuous assessment 100% ;

Semester: 1
Teaching Unit: UEM 1.1.2
Subject: TP Structure of the subject
VHS: 22:30 (TP: 1:30)
Credits: 2
Coefficient 1

Practical Work "Structure of the material"

TP N° 1: Preliminary TP: Safety in the chemistry laboratory and description of the equipment and glassware.
TP No. 2: Change of state of water: Change from liquid state to solid state and from liquid state to vapor state.
TP No. 3: Determination of the quantity of material.
TP No. 4: Determination of molecular mass.
TP No. 5: Uncertainty Calculation - Ion Radius Determination
TP No. 6: Determination of partial molar volumes in a binary solution.
TP N° 7: Qualitative analysis of Cations (1^{st}, 2^{nd}, 3^{rd} and 4^{th} groups).
TP N° 8: Qualitative analysis of Anions.
TP No. 9: Identification of metal ions by the flame method
TP No.10: Separation and recrystallization of benzoic acid.
TP N°11: Construction and study of some compact structures.
TP No.12: Study of ionic structures

Evaluation Method

Continuous assessment 100% ;

References

1. Wow, Devallez, General Chemistry, OPU.
2. S.S. Zumdhal et al., Chimie Générale, De Boeck Université.
3. Y. Jean, Electronic structure of molecules: 1 from atom to simple molecules, 3rd edition, Dunod, 2003.
4. F. Vassaux, La chimie en IUT et BTS.
5. A. Casalot & A. Durupthy, Inorganic Chemistry 2nd Cycle Course, 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.
9. M. Karapetiantz, Constitution de la matière, Ed. --

Semester: 1
Teaching Unit: ETU 1.1.1
Subject: Ethical and deontological dimension (the foundations)
VHS: 22h30 (Lesson: 1h30)
Credits: 1
Coefficient: 1

Contenu de la matière:

Part 1. Introduction to Computer Science (5 Weeks)

1- Definition of IT professions
2- Evolution of computing and computers
3- Information coding systems
4- Principle of operation of an AOP
5- Hardware part of a computer
6- Part, system
Basic systems (operating systems (Windows, Linux, Mac OS,...) Programming languages, application software

Part 2 Algorithm and program concepts (10 Weeks)

1- Concept of an algorithm
2- Organization Chart Representation
3- Structure d'un programme
4- The approach and analysis of a problem
5- Data structure: Constants and variables, Data types
6- Operators: assignment operator, relational operators, logical operators, arithmetic operations, priorities in operations
7- Incoming and outgoing cash transactions
8- Control structures: Conditional control structures, Repetitive control structures

IT 1

The TPs aim to illustrate the concepts taught during the course. These must start with the courses according to the following schedule:

- TP of initiation and familiarization with the computer machine from a hardware and operating systems point of view (exploration of the different functionalities of the OS)
- Introduction TP to the use of a programming environment (Editing, Assembling, Compiling, etc.)
- TP of application of the programming techniques seen in progress.

Evaluation Method

Continuous monitoring: 40%; Examination: 60%.

References

1- John Paul Mueller and Luca Massaron, Algorithms for Large Format Dummies, 2017.
2- Charles E. Leiserson, Clifford Stein and Thomas H. Cormen, Algorithmic: Courses with 957 Exercises and 158 Problems, 2017.
3- Thomas H. Cormen, Algorithms: Basics, 2013.

MATERIAL CONTENTS:

I. Fundamentals – (2 weeks)

cs "Theory of Duty":

4. 4

2. 5. Distinction between different concepts

3. A. Distinction between ethics and morals

1. B. Distinction between ethics and deontology

II. Repositories – (2 weeks)

4. Philosophical references

5. The religious reference

6. The evolution of civilizations

7. The institutional reference

III. University Franchise – (3 weeks)

The Concept of
University Franchises
Regulatory texts
University Franchise
Fees University
Campus Actors

IV. University Values – (2 weeks)

1. Six social values
2. Our community values
3. Work Values

V. Rights and Duties (2 weeks)

1. Student rights

2. The student's homework

3. (b) Working rights of teachers

4. Obligations of the research professor

5. Administrative and Technical Staff

2. VI. University Relations (2 weeks)

1. Definition of the concept of academic relations

2. Student-Teacher Relations

3. Student – Student Relations

4. Student - Staff Relations

5. Student Relations – Associative Members

3. VII. Practices (2 weeks)

1. Best practices For the teacher

2. Best practices For the student

Evaluation Method

Exam 100%

References

1. Compendium of ethics and deontology courses of Algerian universities.
2. BARBERI (J.-F.), 'Morale et droit des sociétés', *Les Petites Affiches,* no. 68, 7 June 1995.
3. J. Russ, *Contemporary Ethical Thought*, Paris, puf, *Que sais-je?,* 1995.
4. LEGAULT, G. A., Professionalism and ethical deliberation, Québec, Presses de l 'Université du Québec, 2003.
5. SIROUX, D., 'Déontologie', in M. Canto-Sperber (ed.), Dictionnaire d 'éthique et de philosophie morale, Paris, Quadrige, 2004.
6. Prairat, E. (2009). Teaching professions at the time of ethics. *Education and Societies, 23*.
7. https://elearning.univ-annaba.dz/pluginfile.php/39773/mod_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ont ologie.pdf .

Semester: 1
Teaching Unit: ETU 1.1.1
Subject: Occupations in Science and Technology 1
VHS: 22h30 (Lesson: 1h30)
Credits: 1
Coefficient: 1

MATERIAL CONTENTS:

1. What is engineering science?
The engineering profession, history and challenges of the 21st century**,** Search for a job/a recruitment advertisement by keyword, develop a simple job description (job title, company, main activities, required skills (knowledge, know-how, relational

2. Electronics, Telecommunications, Biomedical Engineering, Electrotechnics, Electromechanics, Optics & Precision Mechanics:
- Definitions, fields of application (Home automation, on-board applications for the automobile, Video surveillance, Mobile telephony, Fiber optics, Advanced scientific instrumentation, Imaging and medical instrumentation, Giant mirrors, Contact lenses, Transport and distribution of electrical energy, Power generation plants, Energy efficiency, Maintenance of industrial equipment, Elevators, Wind turbines, etc.
- Role of the specialist in these areas.

3. Areas of Automation and Industrial Engineering: - Definitions, areas of application (Industrial automated chains, Numerical Control Machine Tools, Robotics, Inventory Management, Goods Traffic Management, Quality, - Role of the specialist in these areas.

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

1. Industrial Health and Safety (HSI) and Mining Engineering sectors:
- Definitions and areas of application (Safety of property and people, Environmental problems, Exploration and Exploitation of mineral resources, etc.)
- Role of the specialist in these areas.

2. Climate Engineering and Transport Engineering - Definitions, areas of application (Air Conditioning, Smart Buildings, Transport Safety, Traffic Management and Road, Air, Naval,...)
- Role of the specialist in these areas.

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

- Definitions and areas of application (Building Materials, Major Infrastructure for Roads and Railways, Bridges, Airports, Dams, Drinking Water Supply and Sanitation, Hydraulic Flows, Water Resources Management, Public Works and
Spatial planning, Smart cities, etc.)
- Role of the specialist in these areas.

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

Group work: Development of job descriptions for jobs in each sector based on recruitment advertisements found on job application sites (e.g. **http: //www.onisep.fr/Decouvrir-les-metiers**, www.indeed.fr, **www.pole-emploi.fr**) (1 sector / group).
Depending on the capacities of the institutions, recommend calling on the doctoral students and former graduates of the institution in a tutoring/mentoring system where each group can call on their tutor/mentor to develop the job description/ discover the different professions of the ST.

Student's personal work for this subject:
The teacher in charge of this subject can let his students know that he can always evaluate them by offering to prepare job descriptions. Ask students to view a popular science film at home in relation to the chosen profession (after having given them either the film on electronic media or having indicated the internet link to this film) and ask them to then submit a written report or to make an oral presentation of the summary of this film, etc. The improvement of these activities is left to the discretion of the teacher and the training team, who alone are able to define the best way to take into account this personal work in the overall score of the final exam.

Assessment mode: Examination: 100%.

Bibliographic references:

[1] What jobs for tomorrow? Publisher: ONISEP, 2016, Collection: Les Dossiers.
[2] J. Douënel and I. Sédès, Choosing a profession according to your profile, Editions d 'Organisation, Collection: Emploi & carrière, 2010.
[3] V. Bertereau and E. Ratière, For what profession are you made? Publisher: L 'Étudiant, 6th edition, Collection: Métiers, 2015.
[4] Le grand livre des métiers, Publisher: L 'Étudiant, Collection: Métiers, 2017.
[5] Les métiers de l 'industrie aéronautique et spatiales, 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 1.2.1
Subject: Analysis 2
VHS: 67h30 (Course: 1h30, TD: 3h00)
Credits: 6
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: Ordinary Differential Equations
1. Linear first-order differential equations.
1.1 Historical note
1.2 Physical model leading to a differential equation.
1.3 General definitions
1.4 General notions about first-order differential equations.
- General Solution Special solution.

1.5 Separate and separable variable equations.
1.6 First-order homogeneous equations. Definitions & Examples
- Solving the homogeneous equation.

1.7 Equations down to homogeneous equations.
- Solving the linear equation.

1.8 Bernoulli's equation.
- Definition Solving Bernoulli's equation.

2. Second order differential equations
2.1 Historical note
2.2 Homogeneous linear equations. Definition and properties
2.3 Linear second-order 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 admits 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 of the homogeneous equation.
2.5 Non-homogeneous linear equations of the second order Method of the 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 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:
Case where the second member is of the form

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

Functions of several real variables Notions of limit, continuity, partial derivatives, differentiability

2.1 Historical note
2.2 Area of definition.
2.3 Concept of limit.
Introduction. Concept of neighbourhood. Definition of the limit of a function of two variables. Do not confuse limit along a direction and limit.
2.4 Continuity of the functions of two variables.
2.5 Partial derivatives of order one.
Definition of the partial derivatives of order one of a function of 2 variables at a point (x_0,y_0)
The partial derivative function. Partial derivatives of order two, reversal of Continuity and existence of partial derivatives ((? f)/(? x)) and ((? f)/(? y))
2.6 Differentiable functions.
Introduction. Definition of functions Case of the functions of a real variable f:???????→???
Definition of functions Case of the functions of two variables f:?????????→?
Relationship between differentiable function and existence of partial derivatives ((? f)/(? x)) and ((? f)/(? y)). Relationship between differentiability and continuity.
2.7 Concept of differential of a function of two variables.
2.8 Partial derivatives of compound functions.
Partial derivatives of type 1 compound functions. Derivatives of type 2 compound functions.
2.9 Taylor's formula of functions of 2 variables.
Partial derivatives of order n, n>2.
2.10 Differentiable optimization in i^2.
Definitions of local and global optimum. Necessary conditions for optimality. Sufficient conditions for optimality.

Chaptre 3

1. Dual Integrals
1.1 Definition of the double integral
1.2 examples
1.3 Dual Integral Properties

- Linearity
- Preservation of order,
- Additive function

1.4 Fubini's theorem in the case of a bounded domain .
1.5 Calculation of double integrals

- Direct dynamic analysis
- Change of variables in a double integral (Variable change formula).

1.6 Applications:Centre of gravity, Moment of inertia.
2. Triple Integrals
2.1 Generalization of the notion of double integrals to triple integrals.
2.2 Calculation of a triple integral

- Direct dynamic analysis
- Variable change calculation (Variable change formula 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:Centre of gravity, Moment of inertia.

Evaluation Method

Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

[1] Elements of analysis PUBLICATIONS OFFICE Ben Aknoun – Algiers
[2] N. Piskounov, Differential and integral calculation. Mir. editions MOSCOW
[3] J. Dixmier, Undergraduate Mathematics Course. 1st Year Gauthiers-Villars. (Paris, 1976).
[4] R. Murray Spiegel. Theory and Applications of Analysis. McGraw-Hill, Paris 1973
[5] G. Flory, Topology, Analysis. Exercises with solutions. Vuibert. Paris 1978

Semester: 2
Teaching unit: UEF 1.2.2
Subject: Algebra 2
VHS: 45h00 (Class: 1h30, TD: 1h30)
Credits: 4
Coefficient : 2

content of teaching

Chapter 1: Vector Spaces

- Definition (on i and iza).
- Vector subspaces.
- Sum of subspaces.
- Additional subspaces.
- Finite free family. Finite linearly dependent family. Finished

Chapter 2: Linear Applications

- Business Coverage
- Core and image.
- Rank of a linear application.
- The rank theorem.
- Characterization of injection, surjection and bijection.

Chapter 3: Matrices, associated matrices and determinants

- Definition (as an array of numbers). Specific matrices.
- master matrix operations The vector space of the matrices.
- Determinants (definition (order 2, 3 and generalization) and properties).
- Invertible matrix
- Matrix writing of a linear application.
- Match between operations on linear applications and those on matrices.
- Base change matrix (pass matrix).
- Effect of a base change on the matrix of a linear application.

Chapter 4: Systems of linear equations

- Definitions & Interpretation
- Cramer systems (general case).

Chapter 5: Matrix Reduction.

- Eigenvalues
- eigenvector
- Characteristic polynomials. Cayley-Hamilton theorem.
- Characterization of diagonalizable matrices.
- Characterization of trigonalisable matrices.
- Applications of the discount.

[6] **Evaluation Method**

[7] Continuous monitoring: 40%; Examination: 60%.

Bibliographic references

[1] A.KUROSH: Higher algebra course. MIR MOSCOW Edition.

[2] D.FADEEV and I.SOMINSKY: Collection of higher algebra exercises. MIR MOSCOW Edition.

[3] J.RIVAUD: Exercises with solutions volume 1 VUIBERT.

[4] J.RIVAUD: Exercises with solutions volume 2 VUIBERT.

[5] LEBSIR HABIB: Directed works of general algebra. Dar el-houda Ain M'LILA.

[6] Jean-Pierre Escofier: All the algebra of the license. Lecturing and exercises Dunod.

[7] J.Lelong-Ferrand, J.M.Arnaudiès: Mathematics classes. Volume 1 Algebra 3rdedition. Preparatory classes 1st university cycle. Dunod.

[8] A.DONEDDU: algebra and geometry 7 Special Mathematics Undergraduate. Vuibert.

[9] COLLET Valérie: MATHS The whole second year. ellipses

Semester: 2
Teaching unit: UEF 1.2.3
Subject Electricity and magnetism
VHS: 67h30 (Course: 1h30 – TD 3h00)
Credits: 6
Coefficient 3

MATERIAL CONTENTS:

Chapter 1: Electrostatic Field and Potential

– Point load
– The electrical force and Coulomb's law.
– Electric field and potential (discontinuous charge distribution).
– Electrical 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).
– Electrostatics: Gauss Theorem

Chapter 2: Drivers

– Core properties
– Induced load and influencing phenomena
– Electrostatic pressure Capacitors, capacitance (different types), stored energy.

Chapter 3: Electric Current

– Notions of current intensity and density.
– Resistance and Ohm's law, Joule's law.

CHAPTER 4

– 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.
– of the magnetic field
– Rotational magnetic field and Ampère's law.
– Flow of the magnetic field through a closed loop and induction.
– |||UNTRANSLATED_CONTENT_START|||Equations de Maxwell.|||UNTRANSLATED_CONTENT_END|||

Evaluation mode: Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

- Physics 2 Electricity and Magnetism, Harris Benson, Boeck Publishing.
- Physics 2 Electricity and Magnetism, Eugene Hecht, Editions de Boeck.
- General Physics, Electricity and Magnetism, Douglas Giancoli, Editions de Boeck

Semester: 2
Teaching unit: UEF 1.2.4
Subject: Thermodynamics
VHS: 67h30 (Course: 1h30, TD: 3h00)
Credits: 6
Coefficient 3

Subject content :

Chapter I: **Thermodynamics Basics**
I.1 Mathematical Reminder on Partial Derivatives
I.2 Properties and states of a system
I.3 Process, equilibrium and thermodynamic cycle
I.4 specific volume
I.5 Pressure, temperature and energy
Chapter II: **Thermodynamic properties of pure substances**
II.1 Ideal gas
II.2 Actual Gas Behaviour
II.3 Corresponding statements and residual differences
II.4 Properties of Liquids and Solids
Chapter III: **Fundamental Concepts of Thermodynamics**
II.1 First principle and applications
II.2 Entropy and second principle
II.3 Entropic assessment and irreversibility
II.4 Free energy properties and thermodynamic equilibrium
II.5 Chemical potential and fugacity
Chapter IV: **Physical Process Balances**
IV.1 Phase equilibria of a pure substance
IV.2 Thermodynamic properties of phase transitions
IV.3 Ideal behaviour of gas, liquid and solid mixtures
IV.4 Phase equilibria of a compound in ideal mixture
IV.5 Ideal solubility and partition coefficient

Evaluation Method
Continuous monitoring: 40%; Examination: 60%.

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: EMU 1.2.1
Subject 1: TP Electricity and magnetism
VHS: 45h00 (TP: 1h30)
Credits: 2
Coefficient 1

MATERIAL CONTENTS:

At least 5 manipulations **(3 hours / 15 days)**

- Presentation of measuring instruments and tools (Voltmeter, Ammeter, Rheostat, Oscilloscopes, Generator, etc.).
- Kirchhoff's laws (mesh law, knot law).
- Thevenin's theorem
- Association and Measurement of inductances and capacitances
- discharge of a capacitor
- Oscilloscope
- TP on magnetism

Evaluation Method

Continuous assessment : 100 %.

Semester: 2
Teaching unit: EMU 1.2.2
Subject: TP Thermodynamics VHS:
22:30 (TP: 3:00)
Credits: 2
Coefficient 1

Thermodynamics and Mechanics practicals

TP No. 1: Study of the equation of state of a perfect gas.
TP No. 2: Water value of the calorimeter.
TP No. 3: Mass heat: mass heat of liquid and solid bodies.
TP N° 4: Study of the solidification of pure water.
TP No. 5: Latent heat: Latent heat of melting of ice.
TP No. 6: Determination of the latent heat of vaporization.
TP No. 7: Reaction heat: Determination of the energy released by a chemical reaction (HCl/NaOH).
TP No. 8: The thermodynamic functions of an acid-base equilibrium.
TP No. 9: Study of the variation of the pressure as a function of the temperature at equilibrium (l-g) for a pure system: water.
TP No. 10: Vapour pressure of a solution.
TP No.11: Equilibrium diagram for a binary system.
TP No.12: Equilibrium diagram for a ternary system.

Evaluation Method

Continuous assessment: 100 %.

Semester: 2
Teaching unit: UEM 1.2.3
Subject 3: Introduction to programming
VHS: 45h00 (Course: 1h30, TP: 1h30)
Credits: 2
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: Introduction to Computer Science and Programming (1 Weeks)

- History of programming languages, Notion of algorithm and programming, The process of developing a programm Presentation of 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: Inputs/Outputs and Expressions (2 Weeks)

- Use of printf() and scanf() functions, Data formattingm Expressions and evaluation orderm Type conversions

Chapter 4: Conditional Control and Iterative Control Structures (3 Weeks)

- If-elsem instructions Comparison operatorsm Logical operatorsm Switch-casem structure Loops while and do-whilem Loop form Loop nestingm Break and continue instructions

Chapter 5: Functions and Character Tables and Strings (3 Weeks)

- Definition and declaration of functionsm Parameter passingm Return valuesm Recursive functions, Declaration and use of arraysm Multidimensional arraysm Strings in Cm Standard functions for strings

Chapter 6: Pointers and Dynamic Allocation (2 Weeks)

- Memory address conceptm Operators & and *m Memory allocation and releasem Relationship between tables and pointers

Chapter 7: Structures and Enumerations (2 Weeks)

- Definition of structured typesm Access to membersm Structure tablesm Enumeration

Detailed content of TP sessions
TP 1: Taking charge of the environment

- Installing the IDE (Code::Blocks, Visual Studio Code with C Extensions)
- First "Hello World" program
- Compilation and Execution of the Game
- Correction of errors

Variables and Expressions

- Variable declaration and initialization
- Arithmetical Operators
- Simple calculations and display of results

TP 3: Conditional Structures and Iterative Structures

- Implementing programs with if-else
- Using switch-case
- Comparison Operators
- Implementation of while, do-while and for loops
- spin button creation
- Validating User Inputs

4 seat functions:

- Creating and calling functions
- Passing parameters by value
- Organization of the code in function

TP 5: One-dimensional and multidimensional tables

- Manipulation of tables
- Search and sorting (simple algorithms)
- Switching tables to functions
- Creation and handling of matrices
- master matrix operations

Chaînes de caractères

- Manipulating strings with the functions of the string.h library
- Word processing

TP 7: Pointers and dynamic allocation

- Using pointers
- memory allocation
- Dynamic Charts

TP 8: Files

Evaluation mode: Continuous monitoring: 40%; Examination: 60%.

Bibliographic references:

1. Kernighan, B. W., & Ritchie, D. M. (2022). *The C language: ANSI Standard*, 2nd edition. Dunod.
2. Perry, G. (2007). Corrected exercises on Language C, 2nd edition . Dunod.
3. Delannoy, C. (2016). *Programming in C Language: Corrected Courses and Exercises*, 5th Edition. Eyrolles.
4. Tanenbaum, A. S. (2008). Operating Systems With more than 400 exercises, 3rd edition. Pearson.
5. *Yves*, M. (2009). C in action Solutions and examples for programmers in C, 2nd edition, Eni, ISBN10 : 2746052563.
6. Online Resources:

- *Learn C Programming* at https://www.learn-c.org/
- *C Programming* at https://www.tutorialspoint.com/cprogramming/

Semester: 2
Teaching Unit 2
Subject 1: Free and Open Source VHS Software:45h00 (Course: 1h30 & Workshop: 1h30) Credits: 2
Coefficient : 2

Chapter 1: Foundations 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 Licensing (2 weeks)
- Introduction to software copyright
- Main free licenses: GPL, LGPL, BSD, MIT, Apache
- Compatibility between licenses
- Implications for Algerian educational institutions and companies

Chapter 3: Free Operating Systems (3 weeks)
- 8. INTRO TO 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
  - ✓ Word processing
  - ✓ Spreadsheet
  - ✓ Impress (presentation)
- Open document formats
- Migration of existing documents
- Configuration for Algerian context (language, formats)

Chapter 5: Creative Solutions and Development (3 weeks)
- Graphic alternatives: GIMP, Inkscape
- Development tools: Free IDE, Git
- Web tools: free browsers, open source CMS
- Data bases: MySQL, PostgreSQL

Chapter 6: Prospects and Future of Free Software (2 weeks)
- Open source communities and contribution methods
- A. Open source approaches
- Public policies and free software in Algeria
- FOSS-Related Business Opportunities

Workshop

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

Atl. 2: Software management in Linux
- Package managers
- Installation and updates of software.

Configuring Software Repositories

-

Atl. 3: Migration to LibreOffice

- Installing and configuring XXX
- Creating and editing documents with Writer
- Conversion from proprietary to open formats
- Creation of models adapted to the needs of the student

Atl. 4: Spreadsheets and free presentations

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

Atl. 5: Image processing and graphics

- Using GIMP for image editing
- Graphic design with Inkscape
- Comparison with corresponding proprietary tools
- Realization of a simple graphic project

Atl. 6: Web and free databases

- Installation and configuration of an open source CMS (WordPress, Joomla)
- Setting up a MariaDB database
- - création d'un site web
- Securing:

Atl. 7: Collaborative Development

- Using Git for versioning
- Setting up a free development environment
- Participation in a collaborative mini-project
- Using a software forge (GitHub, GitLab)

Assessment mode: 100% review

Bibliographic 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). " Take back control using Linux - 2nd edition". EYROLLES.
3. Stutz, M. (2001). " The Linux Cookbook: Tips and Techniques for Everyday". No Starch Press.
4. Eni Collective. (2009). " Introduction to OpenOffice.org 3, Firefox 3 and Thunderbird Free Software". Eni Editions.
5. François, E. (2009). 3. The economics of FOSS
1. Marie, C. (2014). " Free software for the Maghreb? From theoretical opportunities to empirical realities. Institut de recherche sur le Maghreb contemporain GNU Project Documentation: https://www.gnu.org/doc/doc.html
2. Stallman R (2002). *Free Software, Free Society: Selected Essays of Richard M. Stallman.* GNU Press.

Semester 3
Teaching Unit: UEF 2.1.1
Subject: Analysis 3
VHS: 67h30 (Course: 1h30, TD: 3h00)
Credits: 6
Coefficient 3

MATERIAL CONTENTS:

Chapter 1: Vector Analysis

1. Scalar fields and vector fields - Definition of a scalar field - Definition of a vector field
2. Circulation and gradient - Definition (Circulation of a vector field) - Definition (Gradient of a scalar field) - Definition (Gradient fields)
3. Divergence and Rotational - Definition (Divergence of a vector field) - Definition (Rotational of a vector field) - Definition (Rotational fields) - Definition (Laplacian of a scalar field)
4. Scalar potentials and vector potentials
5. Curvilinear integral
6. Curvilinear integral calculation
7. Green's formula
8. Conditions for a curvilinear integral not to depend on the integration path
9. Surface integrals
10. Surface integrals
11. Stock Formula
12. Ostrogradsky's formulas

Chapter 2: Numerical and Whole Series

I- Digital series.

1. Sub-total Convergence, divergence, sum and remainder of a convergent series.
2. Necessary condition of convergence.
3. Convergent Numerical Series Properties
4. Digital series with positive terms
   - 4.1 Convergence criteria - Necessary and sufficient condition for convergence.
   - 4.2 Comparison criterion - Theorem - Consequence (Equivalence rule)
   - 4.3 Ratio test
   - 4.4 Cauchy's Rule - Theorem
   - 4.5 Cauchy Integral Criterion - Theorem
5. Series with any terms
   - 5.1 Alternate series. Definition of an alternating series Leibnitz's Theorem (Series Theorem
   - 5.2 Absolutely convergent series Definition of an absolutely convergent series Theoreme CVA⇒CVS
   - 5.3 Semi-converged series. Definition of a Semi-Convergent Series Examples
   - 5.4 Abel's Criterion Theorem (Abel's First Criterion for Series)

II- Entire series

1. Definition of an entire series, ABEL's Lemma, Convergence Radius Determination of the Convergence Radius, HADAMARD's Rule.
2. Properties of whole series. Linearity and product of two integer series, Normal convergence of an SE of a real variable under any segment included in the open convergence interval, Continuity of the sum over the open convergence interval, Term-to-term integration of an SE of a real variable over the convergence interval, Term-to-term derivation of an SE of a real variable over the convergence interval.
3. Development in S.E.in the vicinity of zero of a function of a real variable. Function expandable in SE on the open convergence interval. Taylor-Maclaurin series of a class function ∞ Uniqueness of development in H.E.
4. Applications Establish the integer series expansions of the usual functions Search for solution of an ordinary differential equation of the first and second order with variable coefficients in the form of S.E.

Fourier Series

1. General definitions
2. Fourier coefficients.
3. Fourier series developable function.
4. Dirichlet's theorem
5. Equality of Parseval.
6. Application: simple examples of Sturm-Liouville problems.

Chapter 4: Fourier and Laplace Transforms I-
Fourier Transforms

1. Fourier's integral
2. Complex form of the Fourier integral.
3. Definitions and first properties Definition of a Fourier transform and its inverse Derived from the Fourier transform Fourier

Laplace transform

1- Definition of Laplace transform
2 - Laplace transform properties (Uniqueness, Linearity, Scale Factor, Derivation, Integration, Theorems)
3 - Current Laplace transforms
4 - Resolution of differential equations by Laplace transform

Assessment methods: Examination = 60% CC=40%

Bibliographic references:

1. Med El Amrani, Digital Suites and Series, Ellipses.
2. François Liret; Mathematics in Practices, Courses and Exercises; Dunod. (f.p.v.; Int. Mult. Series
3. Marc Louis, Maths MP-MP, Ellipses. INT. Doubles:
4. Denis Leger, PSI. Corrected exercises Maths, Ellipses. (Series of Functions, Whole, Fourier...)
5. Charles-Michel Marle, Philippe Pilibossian, Sylvie Guerre- Delabrière, Ellipse. (Suites, Series, Integrals).
6. Fabrice Lembiez Nathan, All in One, Math Exercises.
7. Valerie Collet, Maths throughout the second year, 361 exercises, class reminders, tips and tricks, ellipses.
8. A.Monsouri, M.K.Belbarki. Element of analysis. Lecturing and exercises University cycle Chiheb. (Double and triple integrals, Series, Fourier and Laplace transforms, 2nd order partial differential equations).
9. 9. B.DEMIDOVITCH. Collection of exercises and mathematical analysis problems11th edition. Ellipses. (Functions of several variables, Series, Multiple integrals

Semester 3
Teaching Unit: UEF 2.1.1
Subject 2: Waves and Vibrations
VHS: 45h00 (Class: 1h30, TD: 1h30)
CREDITS: 4
Coefficient : 2

Part A: Vibration

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

- 1.1 Lagrange equations for a particle
  - 1.1.1 Lagrange's Equations
  - 1.1.2 Case of conservative systems
  - 1.1.3 Case of speed-dependent friction forces
  - 1.1.4 Case of a time-dependent external force
- 1.2 multi-degree-of-freedom system

Chapter 2: Free Oscillations of Single Degree of Freedom Systems 2 weeks

- 2.1 Unamortized oscillations
- 2.2 Free oscillations of damped systems

Chapter 3: Forced Oscillations of Systems at a Degree of Freedom 1 Week

- 3.1 Differential Equations
- 3.2 spring-mass-system
- 3.3 Differential equation solution
  - 3.3.1 Harmonic excitation
  - 3.3.2 Periodic excitation
- 3.4 mechanical impedance

Chapter 4: Free Oscillations of Two-Degree-of-Freedom Systems 1 Week

- 4.1 Introduction
- 4.2 Systems with several degrees of freedom.

Chapter 5: Forced Oscillations of Two-Degree-of-Freedom Systems2 Weeks

- 5.1 Lagrange's Equations
- 5.2 Damper-spring-mass system
- 5.3 Impedance
- 5.4 Apps
- 5.5 Generalization to n-degree-of-freedom systems

Part B: Waves

Chapter 1: One-Dimensional Spread Phenomena **2 Weeks**

- 1.1 I. Generalities and Definitions
- 1.2 Propagation equation
- 1.3 Propagation equation solution
- 1.4 Sinusoidal progressive wave
- 1.5 Overlay of two sinusoidal traveling waves

Chapter 2: Vibratory Strings — 2 Weeks

2.1 Wave Equation
2.2 Traveling waves
2.3 Free oscillations of a finite length rope
2.4 Reflection and transmission

Chapter 3: Acoustic Waves in Fluids — 1 week

3.1 Wave equation
3.2 Sound velocity
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

Evaluation mode: Continuous assessment: 40%; Final examination: 60%.

Bibliographic references 23

1. H. Djelouah; Mechanical Vibrations and Waves – Courses & Exercises (USTHB University website: perso.usthb.dz/~hdjelouah/Coursvom.html)
2. T. Becherrawy; Vibrations, waves and optics; Hermes science Lavoisier, 2010
3. J. Brac; Propagation of acoustic and elastic waves; Hermès science Publ. Canadian Pharmacists Association; 2005.
4. R. Lefort; Waves and Vibrations; Dunod, 2017
5. J. Bruneaux; Vibrations, ondes; Ellipses, 2008.
6. J.-P. Perez, R. Carles, R. Fleckinger; Electromagnetism Foundations and Applications, Ed. Dunod.
7. H. Djelouah; Electromagnetism; Office of University Publications, 2011.

Semester 3
Teaching unit: UEF 2.1.2
Subject 1: Fluid mechanics
VHS: 67h30 (Lesson: 1h30, TD: 1h30, TP:1h30)
Credits: 5
Coefficient 3

Content:

Chapter 1: Fluid Properties **3 weeks**

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

Chapter 2: Fluid Statics 4 weeks

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

Chapter 3 Perfect Incompressible Fluid Dynamics 4 weeks

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

Chapter 4: Real Incompressible Fluid Dynamics 4 weeks

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

Practical Workshop

Lab No. 1: Viscometer

Lab No. 2: Determination of linear and singular head losses

Lab No. 3: Flow rate 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 flow around an obstacle

Lab No. 9: Determination of the Reynolds number: Laminar and turbulent flow

Evaluation mode: 40%; Final examination: 60%.

Bibliographic references:

1- Fundamentals of fluid mechanics 6th Edition, 2009, BR Munson, DF Young TH Okiishi, WW Huebsch 6th Edition John Wiley & Sons
2- Fluid mechanics, YA Cengel - 2010 - Tata McGraw-Hill Education
3- Fluid Mechanics Frank M. White Fourth Edition 2003 McGraw-Hill
4- Fluid Mechanics and Hydraulics 2nd Edition, Ronald v. Giles, Jack B Evett, Cheng Liu, McGraw-Hill
5- S. Amiroudine, J. L. Battaglia, 'Fluid Mechanics Courses and Corrected Exercises'Ed. Dunod.
6- R. Comolet, 'Mécanique des fluides expérimentale', Tomes 1, 2 et 3, Ed. Masson et Cie.
7- R. Ouziaux, 'Applied fluid mechanics', Ed. Dunod.
8- B. R. Munson, D. F. Young, T. H. Okiishi, 'Fundamentals of fluid mechanics', Wiley & sons. R. V. Gilles, 'Fluid mechanics and hydraulics: Courses and problems', Schaum Series, Mc Graw Hill, 1975.

Semester 3
Teaching unit: UEF 2.1.2
Subject 2: rational mechanics
VHS :45h00 (Course: 1h30, TD: 1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: Mathematical Reminders (Vector Computing Elements). 1 week

Chapter 2:General and Basic Definitions 2 weeks

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

Chapter 3: Static. 3 weeks

3.1 Axioms of Statics
3.2 Connections, supports and reactions
3.3 Linkage axiom
3.4 equilibrium conditions
3.4.1 Competing strengths
3.4.2 Parallel forces
3.4.3 Planar forces

Chapter 4: Kinematics of the rigid solid. 3 weeks

4.1 Brief reminders about kinematic quantities for a material point.
4.2 Solid state kinematics.
4.2.1 Translation movement
4.2.2 Rotation around a fixed axis).
4.2.3 Planar movement
4.2.4 Compound movement.

Chapter 5: Mass Geometry. 3 weeks

5.1 Mass of a hardware system
5.1.1 Continuous system
5.1.2. Discrete system
5.2 Full formulation of the centre of mass
5.2.1. Definitions (linear, surface and volume case)
5.2.2 Discrete formulation of the centre of mass
5.2.3 GULDIN's theorems
5.3. Moment and product of inertia of solids

5.4. Inertia tensor of a solid
5.4.1 Special circumstances
principal axes of inertia
5.5. Huyghens' theorem
5.6. Moment of inertia of solids relative to any axis.

Chapter 6: Dynamics of the rigid solid. 3 weeks

6.1 Brief reminders on dynamic quantities for a material point.
6.2 Rigid body kinetics element:
6.2.1 Quantity of movement -
6.2.2 angular momentum
6.2.3 Kinetic energy
6.3 Equation of dynamics for a solid body
6.4 angular momentum axis
6.5 Kinetic Energy Theorem
6.6 Applications:
6.6.1 Pure translation case
6.6.2 Rotation around a fixed axis).
6.6.3 Combined case of translation and rotation.

Evaluation mode: continuous control: 40%; Final examination: 60%.

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

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

Semester 3
Teaching unit: EMU 2.1
Subject 1: Probability & Statistics
VHS: 45h00 (Course: 1h30, TD: 1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Part A: Statistics
Chapter 1: Basic Definitions **(1 week)**

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

Chapter 3: Two Variable Statistical Series
A.3.1 Data tables (contingency table). Point Cloud
A.3.2 Marginal and conditional distributions. Covariance.
A.3.3 coefficient of linear correlation Regression line and Mayer 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 Arrangementen
B.1.2 Coveralls
B.1.3 Switching

Chapter 2: Introduction to Probability **(2 weeks)**
B.2.1 Event algebra
B.2.2 Definitions
B.2.3 Probable Spaces
B.2.4 General probability theorems

Chapter 3: Packaging and Independence **(1 week)**
B.3.1 Packaging
B.3.2 Independence
B.3.3 Bayes theorem.

Chapter 4: Random Variables **1 Week**
B.4.1 Definition and properties
B.4.2 The derivative of a function of a single variable is the rate of change defined by :
B.4.3 Expected value
B.4.4 Covariance and moments.

Chapter 5: Usual Discrete and Continuous Probability Laws **3 Weeks**
Bernoulli, binomial, Fish, ... ; Uniform, normal, exponential,...

Evaluation mode :

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

Bibliographic references:

1. D. Dacunha-Castelle and M. Duflo. Probability and Statistics: Fixed-time issues. Masson.
2. J.-F. Delmas. Introduction to probability calculation and statistics. ENSTA Handout, 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. MONTFORT Mathematical statistics course. Economica.
7. MONTFORT Introduction to Statistics Ecole Polytechnique

Semester 3
Teaching unit: UEM2.1.2
Subject 2: Python programming
VHS: 45h00 (Course: 1h30, TP: 1h30)
Credits: 2
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1. Install and use Python

Chapter 2. Demo - Basics

2-A. Interactive mode and script mode, 2-A-1. Python Calculator,
2.A.2 The use of operators: +, -, *, /, //, %, and **, 2-A-3.c Priority

2-B. Variable and data type:
2.B.1. "Production facilities " 2.B.2. Variable Initialization, Variable Modification, Compound Assignment 2-B-2. Data type:(. Number, Character, String)
2-B-3. Conversion (str function)

2-C. Predefined function
St. 2 c. 1). Use the functions of the math module (abs, max, min, pow, round, sin, sqrt, log, exp, acos, etc.)
2-C-2. Print function
2-C-3. Formatted output (*use format function)* 2-C-4. Fonction input
2-C-5. 2-D Function Import.

2-D. Source code
2-D-1. Variable naming rules
2-D-2. Comment
Chapter 3. Conditional structures
3-1. (Minimum form in if, if-else form, complete form if- elif- else) 3-2. The limits of the simple condition in yew
3-3. Comparison operators 3-4. Preachers and Booleans
3-5 The keywords and, gold and not

Chapter 4. Loops

4.1; The while loop
4-1. The For Loop
4.1; Nested loops
4.1; The break and continue keywords

9-5 . Read the entire file . Error writing to file.
9-6 . Write other data types 9-7 . The Keyword
9-10 Save objects to files 9-11 . Save an object to a file

Lab works

TP 1: Getting started with the Python environment (1 Week)

1. Installing Python and a code editor (VS Code, PyCharm)
2. Getting Started with Python Interpreter
    - Execution of simple commands in interactive mode
    - Using Python as a Calculator
3. Creation and execution of a first Python script

TP 2: Variables, Data Types and Operations (1 Week)

1. Manipulation of fundamental data types
    - Integers, Floats, Strings, Booleans
    - Conversion between data types
2. Arithmetic operations and priorities

TP 3: Conditional and repetitive structures (1 Week)

1. Conditional instructions (if, elif, else)
2. Loops (for, while)

TP 4: Functions and modularity (1 Week)

1. Definition and function call
2. RETURN

TP 5: Data Structures (1 Week)

1. List Manipulation
2. Dictionaries and Tuples
3. Journey and manipulation of data structures

TP 6: File handling and final project (1 Week)

1. Reading and writing text files
2. Final project of your choice:
    - ✓ Command-line task manager
    - ✓ The game of hangman.
    - ✓ Loading data from a file
    - ✓ Interactive quiz with saving scores

Evaluation Method

Continuous assessment =40% ,

Finalexamination = 60%

Bibliographic references:

[1] . Allen B. Downey Think Python: How to Think Like a Computer Scientist, O'Reilly Media,

2015;
[2] . Ramalho, L.. Fluent Python. " O'Reilly Media, Inc.", 2022
[3] . Swinnen, G. Learn to program with Python 3. Editions Eyrolles, 2012;
[4] . Matthes, E. Python crash course: A hands-on, project-based introduction to programming. no starch press, 2019
[5] . Cyrille, H. (2018). Learn to program with Python 3. Eyrolles, 6th edition. ISBN: 978-2212675214
[6] . Daniel, I. (2024). Learn to code in Python, I read
[7] . Nicolas, B. (2024). Python, from the beginner to object programming Courses and corrected exercises, 3rd edition, Ellipses
[8] . Ludivine, C. (2024). Selenium Master your functional tests with Python, Eni

Online Resources:

- Official 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: EMU 2.1
Subject 3: VHS Technical
Drawing: 22:30 (PT: 1:30)
Credits: 2
Coefficient 1

Subject content :

CHAPTER 1: General points.2 weeks

1.1 Usefulness of technical drawings and different types of drawings.
1.2 Drawing materials.
1.3 Standardization (Line Types, Writing, Scale, Drawing and Folding Format, Cartridge, etc.).

Chapter 2: Elements of Descriptive Geometry 6 Weeks

2.1 Notions of descriptive geometry.
2.2 Orthogonal projections of a point - Outline of a point - Orthogonal projections of a straight line (arbitrary and particular) - Outline of a straight line - Traces of a straight line-Projections of a plane (arbitrary and particular positions) - Traces of a plane.
2.3 Views: Choice and arrangement of views – Dimensioning - Slope and conicity - Determination of the 3rd view from two given views.
2.4 Method of executing a drawing (layout, straight at 45°, etc.)
Application Exercises and Assessment (AP)

Chapter 3: Perspectives 2 Weeks

Different types of perspectives (definition and purpose). Application Exercises and Assessment (AP).

Chapter 4: Cuts and Sections 2 Weeks

4.1 Sections, standard representation rules (hatching).
4.2 Projections and section of simple solids (Projections and sections of a cylinder, prism, pyramid, cone, sphere, etc.).
4.3 Half Cup, Partial Cuts, Broken Cuts, Sections, etc.
4.4 Technical vocabulary (terminology of machined shapes, profiles, piping, etc.

Application Exercises and Assessment (AP).

Chapter 5: 2 Week Quotation

5.1 General principles
5.2 Quotation, tolerance and adjustment.
Application Exercises and Assessment (AP).

Chapter 6: Concepts on definition and assembly drawings and nomenclatures.

1 Week

Application Exercises and Assessment (AP).

Recommendation: A large part of TP should be in the form of personal work from home.

Mode d'evaluation: Continuous monitoring: 100%.

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

1. Chevalier A. Edition Hachette Technique industrial designer's guide;
2. The technical drawing 1st part descriptive geometry Felliachi d. and Bensaada s. Edition OPU Algiers;
3. The technical drawing 2nd part the industrial drawing Felliachi d. et bensaada s. Edition OPU Algiers;
4. First notions of technical drawing Andre Ricordeau Edition Andre Casteilla;
5. **يعانصلا مسرلا بلإ لخدملا** دجام دبع ديمحلا ناويد رئازجلا قيعماجلا تاعوبطملا.
6. **قيساسأ ئدابم يعانصلا مسرلا يف** وبأ رمع كينح دهعملا يرئازجلا عبط قيعانصلا قيكلملاو سييقتلل ديمحلا ناويد قيعماجلا تاعوبطملا رئازجلا.

Semester 3
Teaching Unit: EMU 2.1
Subject 4: TP VHS Waves and Vibrations: 22:30 (TP: 1:30)
Credits: 2
Coefficient 1

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TP.1 Spring Mass TP.2
Single Pendulum TP.3
Torsion Pendulum
TP.4 Free and forced oscillating electrical circuit
TP.5 Coupled clocks
TP.6 Transverse oscillations in vibrating strings TP.7
Throat pulley according to Hoffmann
TP.8 Electromechanical Systems (The Electrodynamic Speaker) TP.9
Pohl's Pendulum
TP.10 Propagation of longitudinal waves in a fluid.

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

Evaluation mode : Continuous assessment 100%.

Bibliographic references

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

Semester 3
Teaching unit: UED 2.1
Subject 2: Metrology
VHS: 10:30 pm (Class: 1:30 am)
Credits: 1
Coefficient 1

Subject content :

Chapter 1: Metrology Overview **2 Weeks**

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

Chapter 2: The International SI Measurement System 3 Weeks

2.1 Basic quantities and their units of measurement;
2.2 Additional quantities;
2.3 derived units of measurement

Chapter 3: Metrological Characteristics of Measuring Devices 6 Weeks

3.1 Error and uncertainty (Accuracy, precision, fidelity, repetitiveness, reproducibility of a measuring device
3.2 Measurement errors
3.2.1 Gross value
3.2.2 Systematic error
3.2.3 Gross value
3.3 Incidental errors
3.3.1 Random errors;
3.3.2 parasitic errors;
3.3.3 Estimated systematic errors.
3.4 Confidence Interval
3.5 Technical uncertainty;
3.6 uncertainty
3.7 Complete measurement result;
3.8 Identification and interpretation of the specifications of a definition drawing with a view to inspection;
3.9 Basics of gauges, gauges and simple measuring instruments.

Chapter 4: Measurement and Control 4 Weeks

4.1 Direct measurement of lengths and angles (use of ruler, caliper, of the micrometer and the angle protractor);
4.2 Indirect measurement (use of comparator, standard shims);
4.3 Control of dimensions (use of pads, jaws, etc.);
4.4 Measuring and control machines used in mechanical workshops (use of pneumatic comparator, profile projector and roughness meter.

Evaluation method :Final exam (%): 100%

Bibliographic references:

1- Manual of Mechanical Technology, Guillaume SABATIER, et al Ed. Dunod.
2- Memotech: productique matériaux et machinage BARLIER C. Ed. Casteilla
3- Industrial Sciences MILLET N. ed. Casteilla
4- Memotech: Industrial Technologies BAUR D. et al , Ed. Casteilla
5- Dimensional metrology CHEVALIER A. Ed. HACHETTE, [1979].
6- Drilling , milling JOLYS R and LABELL R. Ed. HACHETTE, [1979].
7- Guide to mechanical manufacturing PADELLA P. Ed. Dunod.
8- Technology: first part, Bensaada S and FELIACHI d. Ed. Algiers
9 -ايجولونكت تايلمع عينصتلا د زاوف و ز ريرخ. ةيعماجلا تاعوبطملا ناويد رئازجلا

Semester *4*
Teaching unit: UEF 2.2.1
Subject 1: Heating and air conditioning VHS: 45h00 (Course: 1h30; TD: 1h30)
CREDITS: 4

MATERIAL CONTENTS:

Chapter 1: General **2 weeks**
Thermal comfort, Room temperatures, Outdoor climatic conditions

Chapter 2: Thermal calculation of walls **2 weeks**
Characteristics of the materials, Insulating materials, Choice of walls, Calculation of the thermal resistances of the walls, Checks of the thermal resistances with respect to the minimum resistances required.

Chapter 3: 3-Week Condensation Study
Properties of humid air and psychometric diagrams, Condensation phenomenon: (causes and remedies), Verification of surface condensation, Verification of condensation in the mass

Chapter 4: Calculation of heat losses under steady-state conditions **3 weeks**
Calculation of losses by transmission, Calculation of losses by ventilation, Heat balance

Chapter 5: Heat Source Power Calculation **4 weeks**
Combustion, Thermal appliances (boilers, chimney, heat exchangers, etc.), Sizing of thermal appliances, Installations of thermal appliances

Chapter 6: General information on heating installations **1 week**
Central Heating

Evaluation method: Continuous assessment + Examination

REFERENCIAS

1- RIETSCHEL, H., RAISS, W, Milking Heating and Air Conditioning Volume 1 and Volume 2, Dunod, 1993.
2- Le RECKNAGEL, Climatic Engineering (5th Edition), Hermann, 2013
3- Philippe Ménard, Jack Bossard, Jean Hrabovski, Practice of heating, , Dunod, 2014

Semester *4*
Teaching unit: UEF 2.2.1
Subject 2: Electricity
VHS: 10:30 pm (Class: 1:30 am)
Credits: 2
Coefficient 1

Chapter 1: General introduction **(1 week)** Different types of electrical energy sources (hydraulic, thermal, nuclear, solar, wind, power, etc.), Production and transport of electrical energy.

Chapter 2: DC Circuits **(4 weeks)**
Electrical Circuit Components (Voltage Source, Conductors, Semiconductors, Insulators, Capacitor: Capacitance), DC Electrical Circuit Calculation Method (Kirchhoff Laws, Dummy Current Method), DC Electrical Circuit Calculation Method (Nodal Voltage Method, Dipole Association: Equivalent Electrical Circuit), DC Power (Power Measurements).

Chapter 3: Magnetic Circuits **(2 weeks)**
Magnitudes of the magnetic circuit (Magnetic induction magnetic fields, magnetic flux, Self-inductance - mutual inductance, Magnetic losses), Magnetic circuit study (Electrical analogy, Hopkinson's laws).

Chapter 4 AC Circuits **(4 weeks)**
Study of the single-phase circuit (Symbolic method: complex impedance, power factor calculation), Study of the single-phase circuit (Power calculation: active, reactive and apparent),

Three-phase circuit study (Balanced three-phase circuit, Unbalanced three-phase circuit), Three-phase current powers: active reactive and apparent (Three-phase power measurements: wattmeter method)

Chapter 5: Electrical Machinery **(4 weeks)**
Electric Power Transformers (Single Phase Transformer), Static Machines: Electric Power Transformers (Three Phase Transformer), Rotating Machines: Electric Motors (DC Motors), Rotating Machines: Electric Motors (Synchronous Motors, Asynchronous Motors).

Evaluation method: Exam 100%

Bibliographic references:

1- Théodore Wildi and Gilbert Sybille, Electrotechnique, DeBoeck Unversité, 4th edition. 2005.
2- J. Chatelain , Electrical Machines. EPFL Edition Georgi Electricity Treaty. 1983
3- F. de Coulon, M. Jufer, Introduction to Electrical Engineering. Georgi Edition. 1978.

Semester *4*
Teaching unit: UEF 2.2.2
Subject 1: Complex analysis
VHS: 45h00 (Course: 1h30; TD: 1h30)
CREDITS: 4
Coefficient : 2

Chapter 1: Holomorphic Functions. Cauchy Riemann Conditions **3 Weeks**

Chapter 2: Whole Series **3 Weeks**
The convergence radius is of . Area of convergence. Whole series development. ADVANCED ANALYTICS
Laurent series and Laurent series development

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

Chapter 4: Applications **4 weeks**
Equivalence between holomorphy and Analyticity. Maximum Theorem. Liouville's theorem. Rouché's theorem. Residue Theorem. Calculation of integrals by the Residual method.

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

Evaluation method: Continuous assessment + Examination

Bibliographic references:

1- Henri Catan, Elementary Theory of Analytical Functions of One or More Complex Variables. Publisher Hermann, Paris 1985.
2- Jean Kuntzmann, Complex Variable. Hermann, Paris, 1967.Neuroscience textbook, undergraduate level
3- Herbert Robbins Richard Courant. What is Mathematics?, Oxford University Press, Toronto, 1978. Conventional extension work.
4- Walter Rudin, Real and Complex Analysis. Masson, Paris, 1980. Second cycle manual.

Semester *4*
Teaching unit: UEF 2.2.2 Subject 2:
Digital methods
VHS:67h30 (Lesson: 1h30;TD: 1h30, TP 1H30)
CREDITS: 4
Coefficient : 2

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

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

Chapter 2: Polynomial Interpolation **2 weeks**

1 . GENERAL INTRODUCTION Lagrange polynomial, 3. Newton's 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: Digital Integration **2 weeks**

1 . GENERAL INTRODUCTION Trapezoid method, 3. Simpson's method, 4. Squaring formulas.

Chapter 5: Solving Ordinary Differential Equations (Initial Condition or Cauchy Problem). **2 weeks**

1 . GENERAL INTRODUCTION Euler's Method Improved Euler method, 4. Runge-Kutta method.

Chapter 6: Method of Direct Solving of Systems of Linear Equations **2 weeks**

1. Introduction and Definitions Gaussian method and pivoting, 3. Factoring method LU, 4. Choeleski factorization method MM^t, 5. Thomas algorithm (TDMA) for tri-diagonal systems.

Chapter 7: Approximate Method of Solving Systems of Linear Equations **2 weeks**

1. Introduction and Definitions Jacobi's method, 3. Gauss-Seidel method Use of relaxation.

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

References:

1- C. Brezinski, Introduction to the Practice of Numerical Computation, Dunod, Paris 1988.
2- G. Allaire and S.M. Kaber, Digital Linear Algebra, Ellipses, 2002.
3- G. Allaire and S.M. Kaber, Introduction to Scilab. Corrected Practical Exercises in Linear Algebra, Ellipses, 2002.
4- G. Christol, A. Cot and C.-M. Marle, Differential Calculation, Ellipses, 1996.
5- M. Crouzeix and A.-L. Mignot, Numerical Analysis of Differential Equations, Masson, 1983.
6-S. Delabrière and M. Postel, Approximation methods. Differential equations. Apps Scilab, Ellipses, 2004.
7- J.-P. Demailly, Numerical Analysis and Differential Equations. Presses Universitaires de Grenoble, 1996.
8- E. Hairer, S. P. Norsett and G. Wanner, Solving Ordinary Differential Equations, Springer, 1993.
9- P. G. Ciarlet, Introduction to Matrix Numerical Analysis and Optimization, Masson, Paris, 1982.

Lab Numerical Methods

Chapter 1: Solving Nonlinear Equations **3 Weeks**

1.Method of bisection. ' 2 Fixed point method, 3. Newton-Raphson method

Chapter 2: Interpolation and Approximation **3 weeks**

1.Newton interpolation, 2. Chebyshev's Approximation

Chapter 3: 3-Week Digital Integrations

1.Rectangle Method, 2. Trapezes method, 3. Simpson's method

Chapter 4: 2-Week Differential Equations

1.Euler's Method Runge-Kutta methods

Chapter 5: 4-Week Systems of Linear Equations

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

Bibliographic references 23

1. Algorithms and numerical calculation: practical work solved and programming with Scilab and Python /José Ouin software,. - Paris: Ellipses, 2013 . - 189 p.
2. Mathematics with Scilab: calculation guide programming graphical representations; in accordance with the new program MPSI /Bouchaib Radi,; Abdelkhalak El Hami . - Paris: Ellipses, 2015 . SG-180-P
3. Numerical methods applied: for the scientist and the engineer /Jean-Philippe Grivet,. - Paris: EDP Sciences, 2009 . - 371 p.

Semester *4*
Teaching unit: UEF 2.2.3
Subject 1: VHS Heat Transfer: 45h00
(Course: 1h30;TD: 1h30)
CREDITS: 4
Coefficient : 2

Chapter 1: Introduction to Heat Transfer (2 weeks)
Heat transmission among other sciences and in engineering programs, The different mechanisms of heat transfer, Definitions and laws, Combination of the three modes of transfer.

Chapter 2: General on conduction (4 weeks) General (Fourier's law, thermal conductivity, general equation of thermal conduction. Special cases, Border conditions and initial conditions), One-dimensional steady-state conduction (Simple and composite systems - Planar, cylindrical, circular geometry-), - Thermal resistance. Insulation critical-radius insulation-, heat sources, fins and extended surfaces. Fin equation, Transient conduction (Biot and Fourier numbers, Negligible and non-negligible internal resistance, Resolution methods for systems with negligible internal resistance).

Chapter 3: Convection General (3 weeks)
General (Basics and general formulation, Dimensional analysis), Forced convection (External and internal flows), Natural convection, Phase changes Boiling and condensation.

Chapter 4: General Information on Heat Radiation (3 weeks)
General (Definitions and laws (emissive power, black body, coefficients: Emission, absorption, reflection and transmission, Kirchoff's Laws. Grey surface), Radiative exchanges, Angle factors (view, configuration), Radiative exchanges in grey enclosures.

Chapter 6: Heat Exchangers (3 Weeks)

The various functions of the heat exchangers (with or without change of state). General construction elements: tube exchangers, welded plates, plates and joints.

The three modes of fluid circulation. Heat transfer in exchangers without phase change. The logarithmic mean temperature difference (DTLM).) and the heat transfer coefficient (

Evaluation mode

Continuous assessment + Examination

References:

1- Sacadura, Introduction to heat transfers, , TEC & DOC.
2- Bernard Eyglunent, Manuel de thermique; théorie et pratique (2nd edition) , HERMES, 2000.
3- Jean-Luc Battaglia, Andrzej Kusiak , Jean-Rodolphe Puiggali, Introduction to heat transfers Corrected courses and exercises. DUNOD, 2014
4- De Vriendt, Swift, Small, Heat Transmission
5- Heat and mass transfer (Eckert),
6- R. Siegel and J. Howell, "Thermal radiation heat transfer", 2nd ed., McGraw-Hill, NY, 1981.

Semester *4*
Teaching Unit 2
Subject 1: VHS Computer Aided Drawing:
10:30 PM (TP: 1h30)
Credits: 2
Coefficient 1

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

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

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

4. 3D MODEL DRAWING **(3 weeks)**
4.1 Editing the drawing and the cartridge:
4.2 Choice of views and layout:
4.3 Claddings and Object Properties (Hatching, dimensioning, text, tables, etc...

5. Assemblies **(2 weeks)**
5.1 Assembly constraints (parallel, coincident, coaxial, fixed, etc.):
5.2 Production of assembly drawings:
5.3 Assembly drawing and parts nomenclature:
1. Exploded View

Evaluation mode

Continuous assessment

References:

- Solidworks bible 2013 Matt Lombard, Wiley Edition,
- Technical drawing, Saint-Laurent, GIESECKE, Frederick E. Éditions du renouveau pédagogique Inc., 1982.
- Exercises in drawing parts and mechanical assemblies with the SOLIDWORKS software, Jean-Louis Berthéol, François Mendes,
- CAD accessible to all with SolidWorks: from creation to production volume 1 Pascal Rétif,
- Industrial Designer's Guide, Knight A, Technical Hatchet Edition,

Semester *4*
Teaching unit: UEM2.2
Subject 2: TP Fluid mechanics
VHS: 22:30 (TP: 1h30)
Credits: 2
Coefficient 1

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

Evaluation mode :

Continuous assessment 100%.

Semester *4*
Teaching unit: EMU 2.2
Subject 4: TP Electricity
VHS: 15:00 (TP: 1h00)
Credits: 1
Coefficient 1

Course Content:

- TP No. 1: Familiarization with Laboratory Equipment
  - The voltmeter
  - The ammeter
  - The ohmmeter
  - The multimeter
  - The GBF (Low-Frequency Generator)
  - Stabilized Power Supply
  - The oscilloscope
- TP No. 2: Use of Measurement Instruments in DC and AC
- TP No. 3: Resistance Measurement Using the Wheatstone Bridge
- TP No. 4: Power Measurement
-

Evaluation mode : 100%.

Continuous assessment

Semester *4*
Teaching unit: EMU 2.2
Subject 5: TP Thermal Transfer
VHS: 22:30 (TP: 1h30)
Credits: 2
Coefficient 1

Course Content:

TP N°1: Free Convection

PT #2: Forced Convection

TP No.3: Conduction in metals

TP No.4: Conduction in building materials

TP No.5: Radiation

Evaluation mode : 100%

Semester *4*
Teaching unit: UED 2.2
Subject 1: Notions of architecture
VHS: 22:30 (course: 1:30)
Credits: 1
Coefficient : 1

Chapter 1: Genesis of the 2-week form
The static point, The dynamic point, Of the plane, Of the volume, Thickness of the model

Chapter 2: Composition **5 weeks**
Definition, The ordering mode in the composition, Symmetry, Asymmetry, Dissymmetry, Repetition, Rhythm, Unity and variety, Balance, Harmony, Contrast, Hierarchy.

Chapter 3: Wefts **2 weeks**
Field of use of frames, Some elements of history, Types of frames, Non-metric dimensions, The decimal metric system.

Chapter 4: Proportions **3 weeks**
Arithmetic proportions, Geometric proportions, Harmonic proportions, The modulor, The modulus, The scale

Chapter 5: Architectural Drawing **3 weeks**

Evaluation mode : Exam 100%

REFERENCIAS

1- Gérard Calvat,, Initiation au dessin de bâtiment, Eyrolles (3rd edition), 2001.
2- Alain Sihr,Lecture de plans et dessin technique en bâtiment, Edition Nathan, 2004
3- Jean-Pierre GOUSSETTechniques of the building drawings - Technical drawing and plan reading *Principles and exercises.*. White BTP collection. 2011

Semester *4*
Teaching Unit 2
Subject 2: Notions of control and regulation:
VHS :22:30 (class: 1h30)
Credits: 1
Coefficient 1

Chapter 1: Introduction **1 week**
Objectives - Classification, Continuous and Discontinuous Systems, Open and Closed Loops, Regulation and Control: Signals - Advantage of Regulation.

Chapter 2: Laplace Transform **3 weeks** Definition - Usual Transforms, Properties - Inverse Transform, Differential Equation Relationship and Transfer Function, Examples of Transfer Function (Electrical -Mechanical -Thermal-Hydraulic), Usual Forms of Transfer Functions.

Chapter 3: Temporal response of linear systems **3 weeks** Analysis of linear systems, Transient analysis and Harmonic analysis, 1st order system, 2nd order system, Identification of aperiodic systems: STEJC model

Chapter 4: Frequency response of linear systems **3 weeks**
Harmonic response - Definition, Representations of transfer functions: BODE - BLACK – NYQUIST, Representation of BASIC models.

Chapter 5: Looped Systems **1 Week**
Closed Loop Transfer Function, FTBO/FTBF Comparison, Unit Return Transfer Function and relationship between FTBO - FTBF.

Chapter 6: System Performance **2 weeks**
Loop Stability, Stability Margins (Phase Margin and Gain Margin), Loop Gain Adjustment, Precision of Slaving (Static and Dynamic), Speed of Slaving, Sensitivity to Slaving.

Chapter 7: Performance Improvement **2 weeks**
Progressive correctors, Improvement of accuracy and speed, Adjustment criteria, ZIEGLER- NICHOLS CRITERION

Evaluation mode :Exam 100%

Bibliographic references:

1- Scarf and Calvet: Continuous Linear Controls - Dunod
2- J. Stefano: Servo Systems (volumes 1 and 2) - Schaum

3- M. Djeddi: Linear Servo Systems - OPU
4- Ikni and Benbaouche: Continuous Linear Servos - OPU
5- Dindeleux: Industrial regulation technique - Eyrolles
6- J.M. Flaus: Industrial regulation - HERMES
7- P. De Larminat: Automatic, Control of linear systems - HERMES
8- R. CYSSAU: Technical Management Manual
9- Jean DESMONS: Regulation IN CLIMATE ENGINEERING

Semester: 4
Teaching Unit 2
Subject: Expression, Information and Communication Techniques
VHS:10:30 pm (Course: 1h30)
Credits:1
Coefficient:1

MATERIAL CONTENTS:

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

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

Chapter 3: Developing autonomy, organizational and communication capacity as part of a project approach (**2 weeks)**

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

Chapter 4: ICT - Definition and Evolution **(2 weeks)**
Definition, ICT Activities, ICT Skills Mastery, ICT Evolution, Information and Communication Services

Chapter 5: Research, Use and Retrieval of Information. **(2 weeks)**
Search directories (YAHOO, GOOGLE), Search engines, The query and search language, Retrieving and printing an HTML page, Retrieving an image, Downloading a file or software, Reading an HTML file locally, Reading a multimedia file saved on the Web.

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

Chapter 7: Securing Sensitive Information, Protecting Confidential Data, and Preserving Harm. **(3 weeks)**
Safeguarding of important data, "IT and freedoms" law, Internet dangers, Computer hacking, Machine protection, Virus protection, Protection against cyber threats or online threats (Phishing, spam emails, spyware, malware, ransomware, viruses and trojan horses, man-in-the-middle attacks, etc.), Prevent data loss, Spam, Hoax, Cryptology, Electronic signature, etc.

Evaluation Mode: Final exam (%): 100%

Bibliographic references:

(*Drunk and copied, websites, etc.)*

1. Jean-Denis Commeignes, 12 methods of written and oral communications – 4th edition, Michelle Fayet and Dunod 2013.
2. Denis Baril, Sirey, Techniques of Written and Oral Expression, 2008.
3. 3- Matthieu Dubost, Improving his written and oral expression all the keys, Ellipses Edition 2014.
4. Allegrezza Serge and Dubrocard Anne (edited by). Internet Econometrics. Palgrave Macmillan, Cham. ISBN-10: 0230362923; ISBN-13: 9780230362925
5. Anduiza Eva, Jensen J. Michael and JorbaLaja (edited by). Digital Media and Political Engagement Worldwide. Cambridge UniversityPress - M.U.A, 2012. ISBN-10: 1107668492; ISBN-13: 9781107668492
6. Baron G.L., and Bruillard E. Computer science and its users in education. Paris: Éditions du Seuil, 2007.
   ISBN-10: 2130474926; ISBN-13: 978-2130474920
7. OnlineC hauntingP. and Le Diberder A. Digital revolution and cultural industries. Points of Reference Paris: La Découverte. ISBN-10: 2707165050; ISBN-13: 978-2707165053
8. Dawn Medlin B. Integrations of Technology Utilization and Social Dynamics in Organizations. Information Science Reference (Isr), 2012. ISBN-10: 1-4666-1948-1; ISBN-13: 978-1-4666-1948
9. Devauchelle B. How digital technology is transforming places of knowledge. FYP Editions, 2012. ISBN-10: 2916571612; ISBN-13: 978-2916571614
10. Greenfield David. "The Addictive Properties of Internet Usage". internet, addiction 13315.3John Wiley & Sons, Inc., 2007. ISBN: 9780470551165. http://dx.doi.org/10.1002/9781118013991.ch8.
11. Kurihara Yutaka et [Al.]. Information technology and economic development. Information Science Reference (Isr), 2007. ISBN 10: 1599045818; ISBN 13: 9781599045818
12. Paquelin D. The appropriation of digital training devices. From prescribed to uses. Paris, L'Harmattan. ISBN-10: 2296085563; ISBN-13: 978-2296085565
13. Tansey Stephen D. Business, information technology and society. Routledge Ltd, 2002. ISBN-10: 0415192137; ISBN-13: 978-0415192132

Semestre *5*
Teaching Unit 1
Subject 1: Applied Thermodynamics
VHS: 45h00 (Course: 1h30; TD: 1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: Fundamental Concepts (**3 Weeks)**

Energy, Dimensions and units, Systems, border and external environment (control volume), Variables, states, State variables [mass volume, absolute and effective pressure, temperature, evolutions, cycles.

Chapter 2: First Principle of Thermodynamics (3 **Weeks)**

Heat and work, First principle, Internal energy, Enthalpy, Mass heat.

Ideal gas state equation. Applications of the first principle to ideal gases.

Chapter 3: Second principle of thermodynamics (**4 Weeks)**

Introduction to thermal machines and refrigeration plants (definition and representation. Definition of thermal efficiency and coefficient of performance. second principle of thermodynamics. Reversible and irreversible evolution. Clausius and Entropy inequality

Carnot cycle and T – S Diagram. Ideal gas applications.

Chapter 4: Properties of Pure Substances (**4 Weeks)**

Phase Definition and Phase Balance. Free energy and free enthalpy, Notion of chemical potential, Clapeyron – Clausius relationship, Liquid – vapour state change, Diagrams T – V, P – T and P – V and Thermodynamic tables

Chapter 5: Perfect Gas Mixtures (**1**

Week

Basics, Properties and Behavior, Dalton and Amagat Models

M od e d 'éva lua t ion:

Continuous monitoring: 40%, Examination: 60% .

Bibliographic references:

1. Van Wylen, Sonntag and Desrochers, "Applied Thermodynamics", 2nd edition. Editions du renouveau pédagogique Inc. 1992
2. JM. Sisi . Mcgraw-Hill, “Principles of Thermodynamics.”
3. René Suardet, "Thermodynamics", Technique et Documentation 1982. ISBN 2-85206-167-8.

Semestre *5*
Teaching unit: UEF3.1.1
Subject 2: heating installation
VHS: 45h00 (Course:1h30; TD:1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: General Heating Facilities
(1 Week)

Individual heating, central heating, definition and classification

Chapter 2: Hot Water Central Heating **(3 Weeks)**
Gravity Hot Water Central Heating (Thermosiphon), Pump Hot Water Central Heating (Pulsed), Hydraulic Calculation

Chapter 3: Equipment of Hot Water Heating Installations. **(2 Weeks)** Heating unit, pumps, expansion tank, safety and adjustment devices, control and measurement equipment

Chapter 4: Boiler room and Fireplace **(3 Weeks)**

Technical room: layout, special safety arrangement, basic diagram of the boiler room, regulation, smoke duct (or chimney): sizing

Chapter 5: Other Central Heating Facilities **(3 Weeks)**

Steam heating, hot air heating and radiant heating

Chapter 6: Sizing of Heaters and Boilers **(3 Weeks)**

Evaluation mode:

Continuous monitoring: 40%, Examination: 60%.

Bibliographic references:

1- H. Rietschel & W. Raiss; "Traité de chauffage et de climatisation", Tomes 1 & 2, Dunod 1993.
2- The Recknagel, "Climatic Engineering", Herman 2013.
3- Unified Technical Documents, DTU 65 Heating, CSTB, REEF edition 2004.
4- A. Bontemps et al. "Heat Exchangers. Problems and operation ", Techniques de l 'ingénieur, Traité Génie énergétique. B2344.
5- A. Bontemps et al. "Heat Exchangers. Definitions and general architecture ", Techniques of the engineer, treated Energy Engineering. B2340.

Semestre *5*
Teaching Unit: UEF3.1.1
Subject 3: Fluid Flow
VHS: 22:30 (Course: 1:30)
Credits: 2
Coefficient 1

MATERIAL CONTENTS:

Chapter 1. General fluid mechanics concepts (**2 weeks)**

Newtonian fluid, Compressible and incompressible Navier-Stokes equations, Vortex (or velocity) equation, Initial and boundary conditions, Newton's principle of determinism.

Chapter 2. transition

Notion of hydrodynamic stability, laminar-turbulent transition

Chapter 3. Turbulence developed (**3 Weeks)**

Experimental examples, Essential properties (unsteady, non-linear phenomena, phenomena related to the mechanics of continuous media, diffusive phenomena, related to the nature of the flow, unpredictable, etc.), Practical consequences, Fundamental configurations (wall flows, free flows.

Chapter 4. Experimental and statistical tools (**2 weeks)**

Measuring means and statistical tools. Reynolds decomposition.

Chapter 5. Averaged Equations (**2 Weeks)**

Principle, Notations, Reminder of instantaneous equations. The equations of mean motion, Equations of fluctuating magnitudes, Problems of closing equations.

Chapter 6. Thin film approximation flow (**2 weeks)** Thin film approximation. Flow in the Presence of a Wall, Synthesis of the Empirical Laws of Friction.

Chapter 7. Homogeneous and isotropic turbulence (**2 Weeks)** Fourier Transform. General information on homogeneous and isotropic turbulence, Spectral distribution of turbulent energy. Kolmogorov model, Number of degrees of freedom of a turbulent flow. Resolution constraint for numerical representation of turbulent flow.

Evaluation mode

Exam 100%

Bibliographic references:

1. M. Lesieur, "La turbulence", Presses Universitaires de Grenoble, Ed. 1994
2. R. Schiestel, "Modelling and Simulation of Turbulent Flows", Editions Hermès 1993.
3. R. Ouziaux, J. Perrier, "Applied fluid mechanics", Dunod, 2004.

Semestre *5*
Teaching Unit 2
Subject 1: Sanitation and sanitation facilities
VHS: 45h00 (Course:1h30; TD:1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: Cold Water Supply (**1 Week)**

Cold Water Requirements of Buildings, Water Quality, Design Flow "Gc" Specific Equivalent Usage Pressure "Hu", Industrial Consumption.

Chapter 2: Classification of the indoor cold and hot water distribution system (1 Week)
Network connections, Objective of water use water distribution system pressure system.

Chapter 3: Connection (connection) of pipes (**2 Weeks)** Collective connection, recording of consumed water flows, cold water distribution Calculation of internal cold water distribution networks.

Chapter 4: Hot Water Supply (**1 Week)**
Hot Water Distribution Pipeline – Central Production, Storage, Network Closure and Heat Losses, Hot Water Plant Calculation

Chapter 5: Network Sizing and Calculation (**2 Weeks)**
Network Sizing, Network Size Verification Method, Indoor Facilities for Technology Needs.

Chapter 6: **Indoor distribution of cold water by pumping** (**1 Week)**
Pumping stations, calculation of a cold water supply installation using a single pump, Connecting pumps

Chapter 7: **installations for water storage** (**2 Weeks)** General, external tanks, internal tanks, tank protection and control accessories, calculation of storage tanks.

Chapter 8: Installations for high-rise buildings
(**1 Week)**

Design of facilities for tall buildings

Chapter 9: sewage and rainwater sanitation (**2 Weeks)** General, sanitation system, general layout of sanitation networks, basic elements of an indoor sanitation system, general layout of indoor sewage disposal networks, notions on sanitation networks in small agglomerations.

Chapter 10: Calculation of Sanitation Networks (**2 Weeks)**

Usual problem on pipes, calculation of flow rates, flow velocity, maximum flow condition, calculation of evacuation columns, evacuation of water from basements and areas below the evacuation network.

Evaluation mode

Continuous assessment + Examination

Bibliographic references:

1. A.C. Twort, F. M. Law & F. W. Crowley, “Water Supply”, Third Edition, Arnold International Student Edition, 1994.
2. R. Lollia, "Guide to sanitary facilities", Publisher: Casteilla, 2010.
3. M. Bonte, R. Bourgeois , "Mémotech sanitary and thermal installations", 2011.
4. R. Delebecque & C. Roux, "The sanitary facilities form", Volume 1: Cold Water, 1986.
5. R. Delebecque & C. Roux, "Le formulaire des installations sanitaire", Tome 2: Eau Chaude, 1986.
6. G. Brigaux, "La plomberie- les équipements sanitaire", Eyrolles edition, 1956.

Semestre *5*
Teaching unit: UEF3.1.2
Subject 2: electrical installations
VHS: 45h00 (Course: 1h30; TD: 1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: General Information on Electric Power Generation and Distribution (**1 Week)**

Chapter 2: General Rules for the Execution of Electrical Installations
(**1 Week)**

Classification of structures according to the voltage used, characteristics of insulated wires and cables, designation and identification of insulated conductors, sections of conductors and permissible heating.

Chapter 3: Electrical Pipelines (**1**

Week
General rules concerning the laying of pipes, methods of mounting pipes fixed to the walls, electrical ducts.

Chapter 4: Light installation equipment (**1 Week)**
Classification of the equipment, fuse circuit breaker, interpreters, boxes and branch devices, sockets, sockets.

Chapter 5: Lighting installations (**3 Weeks)**
Light installation diagrams, troubleshooting overview, photometric units, electric light production, incandescent lamps, cold cathode tube, hot cathode lamps, mercury vapor lamps, fluorescent lamps and tubes.

Chapter 6: Electrical lighting of interiors (**2 weeks)**
Conditions to be achieved to obtain rational lighting, measurement of lighting, establishment of a preliminary lighting project, installation of lighting in an apartment, different lighting systems.

Chapter 7: Distribution and subscriber electrical installation (**2 weeks)** Direct current distribution, alternating current distribution, street lamp lighting, connection between the distribution network and the subscriber, risers, control panel.

Chapter 8: Electrical Equipment of Residential Buildings (**3 Weeks)**

Technical regulations for installation and use, constitution of pipelines, technical clauses and specifications of the installation, calculation of conductor sections in an indoor installation, representation and identification of conductors and electrical appliances on plans, common graphic symbols for drawing up schematic and architectural plans of indoor installations.

Chapter 9: the rules of a good electrical installation **(1 Week)**

Evaluation mode

Continuous monitoring: 40%, Examination: 60% .

Bibliographic references:

1. P. Vandeplanque, "Lighting, Basic concepts - Installation project - Corrected exercises", Lavoisier, 5th edition, 2005.
2. T. Galluziaux, David Fedullo, "L 'installation électrique", Eyrolles, 2004.
3. T. Gallauziaux, "L 'installation Électrique", Eyrolles, 2012.
4. D. Fedullo, “The Electricity Ledger: Building Electricity,” Eyrolles, 2009.
5. Longechal, “Electricity and Lighting,” Dunod.

Semestre *5*
Teaching Unit 1
Material 1: Heating TP + Fluid Flow TP
VHS: 22:30 (TP:1:30)
Credits: 2
Coefficient 1

MATERIAL CONTENTS:

TP #1: Heating Base Unit
The production of hot water, the distribution of heat, the study of heating bodies.

TP No.2: Model for the study of thermal dispersion
Calculation of the thermal insulation of the walls, Calculation of the amount of heat transmitted through the walls.

TP #3: Heat Exchanger
Show how different cold water flow rates can affect the performance of the heat exchanger in the case of co-current flow and counter-current flow.

NPWT#4: The Pumps
Operating characteristic of centrifugal pumps, Series and parallel coupling of pumps, Determination of pump power.

TPN°5: Pressure drops
Determine the pressure drops in piping, bypasses, bends, etc., Compose the pressure drops in galvanized steel piping and copper.

Evaluation mode
Continuous assessment : 100%

Semestre *5*
Teaching unit: UEM3.1
Subject 2: TP electrical installations
VHS: 22:30 (TP: 1:30)
Credits: 1
Coefficient 1

MATERIAL CONTENTS:

TP N°1: Construction of electrical installations
Interior lighting, Stairwell lighting (with timer), Power outlet.

TPNo.2: Intervention on electrical cabinets

TP No.3: Components and breakdowns of an air conditioning installation
Familiarity with the electrical connection of a refrigeration compressor, Learning the appearance and operation of electrical components, Detection and identification of 15 different faults.

TP No.4: Electrical failures on complete air conditioning installations
Measurement on partially live components, Detection and identification of 30 different faults, Learning electrical wiring diagrams.

Evaluation mode

Continuous assessment 100%

Semestre *5*
Teaching unit: UEM3.1
Subject 3: TP sanitary facilities
VHS: 22:30 (TP: 1:30)
Credits: 2
Coefficient 1

MATERIAL CONTENTS:

TP N°1: Installation kit for hydro-sanitary installations
Connection of the various elements to the source of cold water and hot water, Study of the operation of the pressurization system, Study of an evacuation and ventilation installation.

TP N°2: Demonstration unit of a drinking water installation TP

N°3: Expansion tank
Study the absorption volume of an expansion vessel as a function of pressure.

TP No.4: Assembly and disassembly of a sanitary installation

Evaluation mode

Continuous assessment 100%

Semestre *5*
Teaching Unit 1
Subject 4: Applied numerical methods (CAD+CFD)
VHS: 45h00 (Course: 1h30; TP: 1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: Fortran Language Reminder (**1 Week)**

Chapter 2: Digital Integration (**1 Week)**

Simpson method, Gauss method.

Chapter 3: Solving Ordinary Differential Equations (**3 Weeks)** Enhanced Euler Method, 4th Order Runge-Kutta Method. Method of predictors – correctors: Adams method, Milne method.

Chapter e 4: Stability and Numerical Error Analysis (**1 Week)**

Chapter 5: Solving Partial Differential Equations (**3 Weeks)**

method of differences Introduction to the finite element method

Chapter 6: Introduction to CAD software (**3 Weeks)** Heat balance modelling: simulation of the influence of the choice of envelope on the thermal performance of a room.

Chapter 7: Introduction to CFD Software: (**3 Weeks)**

Simulation of the distribution of temperatures and air velocities in a room; case of free ventilation.

Practical work: 22:30 PT (CAD and CFD)

Evaluation mode

Continuous assessment 40%+ Examination 60%

Bibliographic references:

1. G.J Borse “Fortran 90 and numerical methods for engineers”, PWS-KENT Publishing Co.
2. Jean Michel Bergheau, "Simulation Numériques des Transferts thermiques", Lavoisier, 2004
3. William H. Press, “Numerical Recipes in Fortran 90 (the art of scientific computing)”, Cambridge university press, 2005.
4. J.P Nougier "Method of numerical calculation" Masson 1996.
5. Michael Metcalf "Fortran 90 the fundamental concepts" Afnor Edition 1993.

Semestre *5*
Teaching Unit 1
Subject 1: Combustion and gas networks
VHS: 22:30 (Course:1h30)
Credits: 1
Coefficient 1

MATERIAL CONTENTS:

Chapter 1:General and Definitions (**1 Week**

Characteristics of the gases and unit systems used.

Chapter 2: Combustion (**3 Weeks)**

General, combustion calculation.

Chapter 3:Burners (**1 Week)**

Definition, burner types, calculation.

Chapter 4: Elements Using Gas (**2 Weeks)**

Types, sizing.

Chapter 5:Condition of use of gas (**2 Weeks)** Review of documents constituting the regulations in force for gas installations, Regulations concerning the storage and use of liquefied hydrocarbons.

Chapter 7: Gas networks for high and public buildings

Chapter 8:Using a Gas Plant
Week **1**

Chapter 9: Gas Distribution by Network (**4 Weeks)**

Determination of the diameters of a domestic gas installation.

Evaluation mode

Exam 100%

Bibliographic references:

1. Technical documents
2. Fluid Mechanics
3. Thermodynamics manuals.

Semestre *5*
Teaching Unit: UED3.1
Subject 2: Renewable Energy
VHS: 22:30 (Course:1h30)
Credits: 1
Coefficient 1

MATERIAL CONTENTS:

Chapter 1. Solar Astronomy **(2 Weeks)**

Chapter 2. Algerian Solar Deposit **(2 Weeks)**

Chapter 3. Thermal Conversion of Solar Energy **(4 Weeks)**

Planar Solar Collectors, Solar Concentration: Cylindrical, Cylindrical-Parabolic-Parabolic, Heliostats, Applications of Solar Thermal Conversion, Solar Heat Storage.

Chaptre 4. Photovoltaic conversion **(3 Weeks)** Physics of photovoltaic cells, The different types of direct conversion cells, The use of direct conversion panels and the notion of service rendered.

Chapter 5. Wind Energy **(2 Weeks)**

Wind deposit, The different types of wind turbines, The use of wind turbines,

Chapter 6. Geothermal **(1Weeks)**

Geothermal energy: Deposits in Algeria and use,

Chapter 7.Biomass **(1 Weeks)**

Biomass: The use of waste.

Evaluation mode

Exam 100%

Bibliographic references:

1. B. Equer, J. Percebois, "Solar photovoltaic energy, 1: Physics and technology of photovoltaic conversion", Ellipses, 1993.
2. P. Gipe, “Wind power: Renewable energy for home, farm, and business”, Chelsea green publishing co, 2004.
3. A. Filloux, “ Integrating Renewable Energy,” 2014.
4. J. Vernier, " Renewable energies", 2014.
5. B. Wiesenfeld, “ Renewable Energy Promises and Realities,” 2013.
6. C. Dubois "Le guide de l 'éolien, techniques et pratiques", Eyrolles, 2009.
7. D. Le Gouriérès, "Les éoliennes Théorie, conception et calcul pratique", Editions du Moulin Cadiou, 2008.
8. A. Damien, " La biomass énergie Definitions, ressources et modes de transformation", 2013.
9. J. Lemale,La geothermal,Dunod, 2012.

P. Van de Maele, Jean-François Rocchi. " Geothermal energy and heating networks",

10. C. Dubois "Le guide de l 'éolien, techniques et pratiques", Eyrolles, 2009.
11. D. Le Gouriérès, "Les éoliennes Théorie, conception et calcul pratique", Editions du Moulin Cadiou, 2008.
12. A. Damien, " La biomass énergie Definitions, ressources et modes de transformation", 2013.
13. J. Lemale,La geothermal,Dunod, 2012.
14. P. Van de Maele, Jean-François Rocchi. " Geothermal energy and heating networks",Publisher(s): ADEME, BRGM, 2003.
15. R. H. Charlier and Charles W. Finkl, “Ocean Energy: Tide and Tidal Power”, 2008.
16. M. E. McCormick, “Ocean Wave Energy Conversion”, 2007.
17. B. Multon, “Marine Renewable Energy Handbook”, 2011.
18. P. Prouzet and A. Monaco, “Development of Marine Resources,” 2014.

Semester *6*
Teaching Unit 2
Subject 1: air conditioning and air conditioning installations
VHS:67h30 (Course: 3h00; TD:1h30)
Credits: 6
Coefficient 3

MATERIAL CONTENTS:

Chapter 1: General (**1 Week)**

Chapter 2: Calculation of expenses (**5 Weeks)**

Inputs due to the external environment, inputs due to the internal environment.

Chapter 3: Air Treatment (**3 Weeks)**

Heating, cooling, humidification, dehumidification, application.

Chapter 4: Air Handling Plant Design (**4 Weeks)**

Basic winter cycles, basic summer cycles, complete plot of air changes.

Chapter 5:Choice of elements of an air handling unit (**2 Weeks)**

Evaluation mode

Continuous monitoring: 40%, Examination: 60%.

Bibliographic references:

1. P. Dal Zotto, J.-M. Larre, A. Merlet, L. Picau, "Memotech, energetic engineering", 2009.
2. The Recknagel, "Climatic Engineering", 5th Edition Herman, 2013.
3. "Principe de l 'aéraulique appliquée au génie climatique", PYC édition .
4. P. Jacquard and S. Sandre, "The practice of air conditioning and thermodynamic heating", 2nd edition, PYC edition, 2007.

Semester *6*
Teaching unit: UEF3.2.1
Subject 2: refrigeration installations
VHS: 45h00 (Course:1h30; TD:1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: General (**1 Week)**

Chapter 2: Refrigerants (**2 Weeks)**

Types (primary and secondary), refrigerant classification, characteristics (thermodynamic, chemical and physical), refrigerant comparison.

Chapter 2: Mechanical Compression Refrigeration Machines
(**5 Weeks)**

Carnot cycle, performance coefficient of the standard cycle and the real cycle, multi-stage compression.

Chapter 4: Elements of Refrigeration Installations
(**5 Weeks)**

Compressors (different types, calculation), Condensers (different types, calculation), Evaporators (different types, calculation), Regulators (different types, calculation), etc.

Chapter 3: Absorption refrigeration machines (**2 Weeks)**
Working principle, different types of refrigerant - absorbent combination (NH_3-H_2O, H_2O –LiBr).

Evaluation mode

Continuous monitoring: 40%, Examination: 60%.

Bibliographic references:

- F. Meunier, P. Rivet, M-F. Terrier, "Le froid industrielle", Dunod, 2005.
- The Recknagel, "Climatic Engineering", 5th Edition, Herman, 2013.
- Le Nouveau Pohlman, "Manuel technique du froid", PYC Editions, 1994.
- Georges Rigot "Froid Commercial, Furniture and refrigerated showcases for food distribution", PYC edition, 1990.

Semester *6*
Teaching unit: UEF3.2.2
Subject 1: Regulation of installations
VHS: 45h00 (Course:1h30; TD:1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: General (**1 Week)**

Objective, Interest, Importance of the material, Examples.

Chapter 2: Principles of the regulation technique. (**2 Weeks)**

Definitions and objectives, Control loops, Composition of the loop to be adjusted, Elements of transfer of the media to be adjusted, Transfer function, Identification of the media to be adjusted, Behaviour in Climate Engineering.

Chapter 3: Adjustment devices. (**2 Weeks)**

General, The different motors, The valves and their characteristics, Classification and Applications in installations, Valves: Assemblies and regulation.

Chapter 4: Basics of Technical Building Management (**2 Weeks)**

The components of the BMS, The functions of the BMS, Equipment to be controlled, Automation, Technical management, Operation, Procedure for setting up a BMS.

Chapter 5: Applications to a Heating Installation (**1 Week)**

Regulators, Control loops, Diagrams and operation.

Chapter 6: Application to a ventilation installation. **1 Weeke)**

Regulators, Control loops, Diagrams and operation.

Chapter 7: Applications to a refrigeration plant (**1 Week)**

Regulators, Control loops, Diagrams and operation.

Chapter 8: Assembly of a BMS (**1 Week)**

Study and installation of a BMS on an Air Conditioning installation and a heating installation.

Evaluation mode

Continuous monitoring: 40%, Examination: 60%.

Bibliographic references:

1. Industrial regulation technique Dindeleux, Eyrolles.
2. J.M. Flaus, "Industrial regulation", Hermes.
3. Manual of Regulation and Technical Management, PYC Edition.
4. J. Desmons, "Regulation in Climate Engineering", Dunod.
5. Development of regulation and BMS. Costic, Editions PYC Livres.
6. J. Desmons, "Aide mémoire en Génie Climatique", Dunod.
7. Techniques The Engineer.

Semester *6*
Teaching unit: UEF3.2.2
Subject 2: Topography
VHS: 45h00 (Course:1h30; TD:1h30)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

Chapter 1: General (**3 Weeks)**

Definitions, scales and units, planimetry, altimetry, geometry and topography, general shapes of the earth, geographical coordinates, projection systems.

Chapter 2: Survey Methods (**2 Weeks)**

Survey of a point, planimetry, altimetry.

Chapter 3: Direct Distance Measurement (**2 Weeks)**

Principle, devices used, method of use, nature of terrain, alignment, errors.

Chapter 4: Direct Leveling (**2 Weeks)**

Definitions, principle, leveling method, precision leveling, errors.

Chapter 5: Measuring instruments and their settings (4 **Weeks)**

Levels, goggles, staffs, goggle levels, theodolites.

Chapter 6: Indirect Distance Measures (**2 Weeks)**

Tacheometry, measurement of elevations (slope terrain).

Evaluation mode

Continuous monitoring: 40%, Examination: 60%.

Bibliographic references:

1. M Brabant, "Maîtriser la Topographie", second edition Paris 2003.
2. M Brabant, "Topométrie Opérationnelle", Technique et Vulgarisation, Paris 1980.
3. R D'Hollander, "Topographie Générale", Editions Eyrolles 1969.
4. J Lamirault, "Cours de Topographie".

Semester *6*
Teaching unit: EMU 3.2
Subject 1: End of Cycle Project
VHS: 45:00 (PT: 3:00)
CREDITS: 4
Coefficient : 2

MATERIAL CONTENTS:

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

Remarque :

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

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

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

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

Evacuation mode:

Continuous assessment

Semester *6*
Teaching unit: EMU 3.2
Subject 2: TP Regulation
VHS: 10h30 (TP: 1h30)
Credits: 2
Coefficient 1

MATERIAL CONTENTS:

TP No.1: Simulator for the automated management of an industrial refrigeration installation
Programmatically produced using a digital multi-adjuster of several variants of refrigeration installation adjustment, Simulation of the actual operating conditions of refrigeration installations.

TP No.2:Regulation of air conditioning and heating installation
Programming of digital regulator, Modification of adjustment parameters of heating and air conditioning installations.

TP N°3: SIM-TRAIN
Control of the ambient temperature by closed-loop regulation.

Evaluation mode
Continuous assessment

Semester *6*
Teaching unit: UEM 3.2
Subject 3: TP Notions of topography
VHS: 22:30 (TP:1:30)
Credits: 1
Coefficient 1

MATERIAL CONTENTS:

TP N°1: Goniometric tracking TP N°2:

Azimuthal tracking

TP N°3: Direct levelling or Goniometric TP N°4:

Levelling by Routing

TP N°5: Measurement of a Distance by Chainage, regular terrain and irregular

terrain TP N°6: Compound Levelling or by Traverse and Radiation

TP N°7: Adjustment of Levels

TP N°8: Setup of a Theodolite, Adjustment of the Base TP N°9:

Setup of a Theodolite, Pivot Setting

TP No.10: Setup of a Theodolite, Horizontal Circle and Vertical Circle

Evaluation mode

Continuous assessment

Semester *6*
Teaching unit: EMU 3.2
Subject 4: TP Air conditioning and cold
VHS: 22:30 (TP:1h30)
Credits: 2
Coefficient 1

MATERIAL CONTENTS:

1st part

TP No.1: Study of the mechanical compression refrigeration machine
Compare theoretical cycle to experimental results, Study the influence of BP and HP on cycle performance.

TP No.2: Study of the absorption refrigerating machine
Understand the basic principle of an absorption refrigeration plant, Main behaviors of the absorption refrigeration machine.

TP No.3: Study bench of the compression refrigeration cycle
Installation charging, Tests of the LP and HP pressure switch safety devices, Measurement of the electrical energy absorbed by the compressor, Analysis of the behaviour of the refrigeration installation according to the variation of the liquid flow rate, the water flow rate sent to the condenser.

TP #4: Heat Pump
HEAT AND COLD-GENERATING MACHINE

Part 2

TP N°1 Study of an air treatment plant
Compare the theoretical and experimental quantities of heat exchanged in the following cases: Heating, Cooling above the dew point, Cooling below the dew point.

TP N°2 Base unit of an air conditioning unit combined with a refrigeration installation Testing of the complete cycle of the air conditioning, Heating and humidification, Cooling and dehumidification.

Evaluation mode
Continuous assessment

Bibliografic references

1. Samuel Courgey and Jean-Pierre Oliva "Bioclimatic design - Comfortable and economical houses - New and under renovation". Éditions Terre Vivante 2006.
2. At the foot of the wall collection “Restoring your home - Guide to intervention on the building
elder Editions Eyrolles

3. *Thomas Schmitz-Günther. Editions Könemann “Eco-logis - La maison à vivre”.1998 / 1999.*
4. *Oïkos Association. Éditions Terre Vivante "The keys to the ecological house". 2003-2004*
5. *Jean-Pierre Oliva "Ecological insulation - Design, materials, implementation". Terre Vivante 2001 – 2005*
6. *Jean-Louis Beaumier "Ecological sound insulation - Materials, implementation". Terre Vivante 2006.*
7. *Thierry Salomon and Claude Aubert 'Freshness without air conditioning’ - The guide to ecological alternatives. Terre Vivante 2005.*
8. *Sandrine Cabrit-Leclerc "Water at home - ecological instructions for use". Terre Vivante 2005.*
9. *Recovering rainwater Éditions Eyrolles 2006.*
10. *doctors Suzanne and Pierre Déoux. Medieco "The guide to healthy housing". Printouts 2002 28/04/2004 BRIEFS*
11. *Cécile Flé Living in a healthy house ". Éditions Eyrolles 150 pages 2002*
12. *Claude Aubert, Antoine Brosse-Platière and Jean-Pierre Oliva "Ecological houses of today". Terre Vivante 2004.*
13. *David Pearson “Living in Nature - The Ecological Home”. Flammarion Publshing*
14. *Patrick Piro “Guide to green energies for the home”. Éditions Terre Vivante 2006.*
15. *Edward Mazria “The Solar House Guide”. Editing arentheses. 2006.*
16. *up against it "Farms and village houses - 30 examples of rehabilitation". Éditions Eyrolles 2005.*
17. *Dominique Gauzin-Müller 25 ecological houses ". Edition Le Moniteur. 160 pages 2005.*
18. *Dominique Gauzin-Müller “25 wooden houses”. Le Moniteur 2003 edition.*
19. *Joël Cariou "Wooden architects' houses". Alternative Edition. 2003.*
20. *CAUE de l 'Allier "La maison rurale en Bocage bourbonnais - Guide to know and preserve, develop and expand, without betraying 2005.*

Semester *6*
Teaching Unit: UED3.2
Subject 1: Urban Hydraulics
VHS: 22:30 (Course:1:30)
Credits: 1
Coefficient 1

MATERIAL CONTENTS:

Chapter 1: Water Storage Facilities (**3 Weeks)**

General outdoor tanks, underground tanks Semi-underground tanks Water towers.

Chapter 2: Sanitation Networks (**3 Weeks)**

Topographic data, Geological and geotechnical data, Hydrological data.

Chapter 3: Buried Manifolds - Description and Calculations (**5 Weeks)**

Unitary system, Separative system, Hybrid system, Urban aspects of sanitation.

Chapter 4: Water Treatments (**4 Weeks)**

Preliminary treatments, Physical treatments, Biological treatments Chemical treatments.

Evaluation mode

Exam 100%

Bibliographic references:

1. R. Delebecque and C. Roux, "Le formulaire des installations sanitaire", **T**ome 3: Evacuation Fluides Divers, 1986.
2. AGHTM, "Les stations de pompage d 'eau", Editions Tec et Doc, 2000.
3. J. Bonnin, "Urban Hydraulics Applied to Small and Medium Agglomerations", 1986.
4. F. Moran, "Traitement des eaux, Chauffage - Climatisation - Installation sanitaire", Les éditions parisiennes, 2002.

Semester *6*
Teaching unit: UED3.2
Subject 2: Acoustics
VHS: 10h30 (Class:1h30)
Credits: 1
Coefficient 1

MATERIAL CONTENTS:

Chapter 1: Physical characteristics of sound (**2 Weeks)** Notions of acoustics, acoustic pressure, acoustic spectra, acoustic levels, acoustic power.

Chapter 2: Physiological characteristics of sound (**2 weeks)**
Weighted sound levels, octane band gender indices, iso criteria, physiological intensity of sound.

Chapter 3: Equipment-generated Noise (**2 Weeks)**

Fans, refrigeration compressors, cooling towers, pumps...

Chapter 4: Free-field Sound Propagation (**2 Weeks)**

Directionality factor, acoustic screen, sound distribution in a room.

Chapter 5: Noise Transmission in an Aeraulic Network (**2 Weeks)**

Calculation of attenuations in an aeraulic network, calculation of the probable level in a room.

Chapter 6: Noise reduction in premises (**5 Weeks)** Wall treatment, weakening index, reverberation time, acoustic insulation, reduction of solidly transmitted noise, noise reduction in air ducts.

Evaluation mode

Exam 100%

Bibliographic references:

1. Meisser, "La pratique de l 'acoustique dans le bâtiment", Editions Eyrolles.
2. Herman , Le Recknagel; "Génie Climatique", 5th Edition, 2013.
3. A. Capliez, "Génie Energétique", Collection MEMOTECH.

Semester 6:
Teaching unit: ETU 2.6.1
Subject 1: Entrepreneurship & Start-Up
VHS: 22:30 (Course: 1:30)
Credits: 1
Coefficient 1

Chapter 1: Introduction to Entrepreneurship (2 weeks)

- Definition and interrelation 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 the idea to the project

- Identification of business opportunities
- Creativity techniques (brainstorming, mind mapping, etc.)
- Case Study: Failure vs Success

Chapter 2: Identifying Innovative Opportunities (1 week)

- Methods for detecting innovation opportunities
- Analysis of unmet needs of the Algerian market
- Design thinking and user-centred approach
- Creativity and Ideation Techniques

Chapter 3: Business Model Canvas (3 weeks)

- Business Model Canvas
- Value Proposition Definition
- Customer segmentation
- Distribution channels and customer relations
- Cost structure and revenue streams
- Development of disruptive business models

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

- Structure and key elements of the business plan
- Market Research
- Marketing & sales strategy
- Financial aspects
- SWOT Analysis
- Marketing plan, operational plan

Chapter 5: Financing start-ups (3 weeks)

- Avenues of Available Funding
- Public entrepreneurship support schemes (ANSEJ, , incubators, accelerators, CNAC, ANGEM)
- Local and regional orientation of VC and Business Angels (BA)
- Crowdfunding
- Intellectual Property defense
- Tax advantages and specific support for innovative start-ups

Chapter 6: Communication and Leadership (1 week)

- PRESENTATION TECHNIQUES
- Teamwork, conflict management

Chapter 7: Legal and Administrative Aspects (1 week)

- Legal forms of companies in Algeria
- Administrative procedures for creation
- Intellectual Property defense
- Taxation of start-ups

Chapter 8: From concept to realisation - Implementation of the innovative project (2 weeks)

- Development of a minimum viable product (MVP)
- Testing and validation of innovation in the market
- Developmentofan ICZM Strategy
- Effective presentation of an innovative project (pitch)

Evaluation Mode: 100% review

Bibliographic references

1. Christensen, C. M. (2021). **The innovator's dilemma: When new technologies cause large companies to fail**.
2. Nezha D.A. , Mouffok B. (2023). Startups and Entrepreneurship The Future of Algeria European University Editions.
3. Osterwalder, A., & Pigneur, Y. (2011). *Next Generation Business Model: A Guide for Visionaries, Revolutionaries and Challengers*. Pearson.
1. Experts/universities |*Entrepreneuriat : Apprendre à entreprendre*. Dunod.
2. Blank, S., & Dorf, B. (2013). *The Startup Creator Manual: Step by Step, Build a Great Business*. Diateino.
3. Ries, E. (2015). *Lean Startup : Adoptez l'innovation continue*. Pearson.
5. Madoui, M. (2015). *Maghreb Contractors: Land under development*. Karthala.
6. Grim, N. (2012). *Entrepreneurs, Business Creation and Development*. European academic editions.