



People's Democratic Republic of Algeria  
 الجمهورية الجزائرية الديمقراطية الشعبية  
 Ministry of Higher Education and Scientific Research  
 وزارة التعليم العالي والبحث العلمي  
 National Pedagogical Committee in Science and Technology  
 اللجنة التربوية الوطنية في العلوم والتكنولوجيا



# OFFRE DE FORMATION MCIL

## dans le cadre de réseaux thématiques

### L.M.D.

#### MASTER A CURSUS INTEGRE DE LICENCE

# Harmonization of Programs

## 2022

Etablissement	Faculté / Institut	Département
<i>Université de Médéa- Laghouat- Djelfa- Ghardaia</i>	<i>Faculté de Technologie</i>	<i>Génie des Procédés et Environnement</i>
Domain	Sector	Speciality
<i>Sciences and Technologies</i>	<i>Process Engineering</i>	<i>Pharmaceutical Process Engineering</i>



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## عرض للتكوين في إطار الشبكات الموضوعية

### تنسيق البرامج

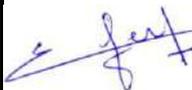
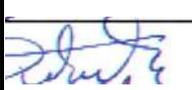
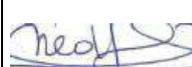
# 2022

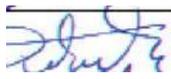
المؤسسة	المعهد /الكلية	القسم
جامعة المدية-الاغواط-الجلافة-غرداية	<b>Faculté de la Technologie</b>	<b>Génie des Procédés et Environnement</b>
التخصص	الفرع	الميدان
هندسة الطرائق الصيدلانية	هندسة الطرائق	علوم وتكنولوجيا

# MOYENS

## Moyens humains

### EQUIPE PEDAGOGIQUE\*:

Nom et Prénom	Département	Spécialité	Grade	Laboratoire de recherche de rattachement	Emargement
FERHAT SAMIRA	Génie des procédés et environnement	Génie des Procédés	Pr.		
FERGANI Zineb	Tronc commun en Technologie	Génie des Procédés	MCA	LBMPT	
KERMET SAID Hadjira	Tronc commun en Technologie	Génie des Procédés	MCA	LME	
KHAOUANE Latifa	Génie des procédés et environnement	Génie des Procédés	Pr.	LBMPT	
KREA MOHAMED	Génie des procédés et environnement	Génie des Procédés	Professeur	Laboratoire de traitement et recyclage des rejets (U Médéa)	
BENKORTBI OTHMANE	Génie des procédés et environnement	Génie des Procédés	MCA	Laboratoire de biomatériaux et phénomènes de transport (U Médéa)	
SI-MOUSSA CHERIF	Génie des procédés et environnement	Génie des Procédés	MCB	Laboratoire de biomatériaux et phénomènes de transport (U Médéa)	
NEDJIOUI MOHAMED	Génie des procédés et environnement	Génie des Procédés	MCA	Laboratoire de traitement et recyclage des rejets (U Médéa)	

<b>CHERIFI HAKIMA</b>	<b>Génie des procédés et environnement</b>	<b>Génie des Procédés</b>	<b>MCA</b>	<b>Laboratoire de biomatériaux et phénomènes de transport (U Médéa)</b>	
<b>HAMADACHE MABROUK</b>	<b>Génie des procédés et environnement</b>	<b>Génie des Procédés</b>	<b>MCB</b>		

**I – Semester Organization Sheets**

**PHARMACEUTICAL PROCESS ENGINEERING LICENCE****SEMESTER 1**

Teaching unit	Subject	Credits	Coefficient	Teaching hours :			Teaching hours : per semester (15weeks)	Complementary consulting work (15weeks)	Assessment mode	
	Entitled			Lecture	Tutorial	PW			Continuous assessment	Exam
Fundamental teaching unit Code: FTU1.1 Credits:18 Coefficients: 9	Mathematics 1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physics1	6	3	3h00	1h30		67h30	82h30	40%	60%
	Structure of Matter	6	3	3h00	1h30		67h30	82h30	40%	60%
Methodological teaching unit Code: MTU1.1 Credits:9 Coefficients: 5	Physics1 (PW)	2	1			1h30	22h30	27h30	100%	
	Chemistry (PW)	2	1			1h30	22h30	27h30	100%	
	Computer science 1	4	2	1h30		1h30	45h00	55h00	40%	60%
	Methodology and Scholarly Writing	1	1	1h00			15h00	10h00		100%
Discovery teaching unit Code: DTU1.1 Credits:1 Coefficients: 1	Trades in sciences and technologies 1	1	1	1h30			22h30	2h30		100%
Transversal teaching unit Code: TTU 1.1 Credits:2 Coefficients: 2	Ethical and professional conduct dimension (foundations)	1	1	1h30			22h30	2h30		100%
	Foreign language 1 (French and/or english)	1	1	1h30			22h30	2h30		100%
<b>Total semester1</b>		<b>30</b>	<b>17</b>	<b>16h00</b>	<b>4h30</b>	<b>4h30</b>	<b>375h 00</b>	<b>375h0 0</b>		

**Semester 2**

Teaching unit	Subject	Credits	Coefficient	Teaching hours : per week			Teaching hours : per semester (15weeks)	Complementary consulting work (15weeks)	Assessment mode	
	Entitled			Lecture	tutorial	PW			Continuous assessment	Exam
<b>Fundamental teaching unit</b> Code: FTU1.2 Credits:18 Coefficients: 9	Mathematics 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Physics 2	6	3	3h00	1h30		67h30	82h30	40%	60%
	Thermodynamics	6	3	3h00	1h30		67h30	82h30	40%	60%
<b>Methodological teaching unit</b> Code: MTU1.2 Credits:9 Coefficients: 5	Physics 2 (PW)	2	1			1h30	22h30	27h30	100%	
	Chemistry (PW)	2	1			1h30	22h30	27h30	100%	
	Computer science 2	4	2	1h30		1h30	45h00	55h00	40%	60%
	Presentation methodology	1	1	1h00			15h00	10h00		100%
<b>Discovery teaching unit</b> Code: DTU1.2 Credits:1 Coefficients: 1	Pharmaceutcal industry	1	1	1h30			22h30	02h30		100%
<b>Transversal teaching unit</b> Code: TTU 1.2 Credits:2 Coefficients: 2	Foreign language 1 (French and/or english)	2	2	3 h00			45h00	5h00		100%
<b>Total semester 2</b>		<b>30</b>	<b>17</b>	<b>16h00</b>	<b>4h30</b>	<b>4h00</b>	<b>375h00</b>	<b>375h00</b>		

**Semester 3**

Teaching unit	Subject	Credits	Coefficient	Teaching hours : per week			Teaching hours: per semester (15weeks)	Compleme ntary consulting work (15 weeks)	Assessment mode	
	Entitled			Lecture	Tutori al	PW			Continuous assessment	Exam
<b>Fondamental teaching unit Code: FTU1.3 Crédits:10 Coefficients:5</b>	Fluid mechanics	6	3	3h00	1h30		67h30	82h30	40%	60%
	Balances - Initiation to unitary operations	4	2	1h30	1h30		45h00	55h00	40%	60%
<b>Methodological teaching unit Code: MTU1.3 Crédits: 8 Coefficients: 4</b>	Surface chemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
	Chemical equilibria	4	2	1h30	1h30		45h00	55H00	40%	60%
<b>Methodological teaching unit Code : MTU1.3 Crédits:9 Coefficients: 5</b>	Fluid mechanics (PW)	2	1			1h30	22h30	27h30	100%	
	Balances (PW)	1	1			1h00	15h00	10h00	100%	
	Chemical equilibria (PW)	2	1			1h30	22h30	27h30	100%	
	Surface chemistry (PW)	2	1			1h30	22H30	27h30	100%	
	Pharmaceutical technology	2	1	1h30			22h30	27h30		100%
<b>Discovery teaching unit Code: DTU1.3 Credits:2 Coefficients: 2</b>	Computer and scientific tools	1	1	1h30			22h30	2h30		100%
	Occupational hazards and their prevention	1	1	1h30			22h30	2h30		100%
<b>Transversal teaching unit Code: TTU 1.3 Credits:1 Coefficients:1</b>	Technical English	1	1	1h30			22h30	2h30		100%
<b>Total semester 3</b>		<b>30</b>	<b>17</b>	<b>13h30</b>	<b>6h00</b>	<b>5h30</b>	<b>375h00</b>	<b>375h00</b>		

## Semester 4

Teaching unit	Subject	Credits	Coefficient	Teaching hours : per week			Teaching hours : per semester (15 weeks)	Complementary consulting work (15 weeks)	Evaluation mode	
	Entitled			Lecture	T	PW			Continuous control	Exam
Fundamental TU Code: FTU 1.4.1 Credits:10 Coefficients : 5	Thermodynamics – Energetics	6	3	3h00	1h30		67h30	82h30	40%	60%
	Chemistry: thermochemistry -kinetic	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Code: FTU 1.4.2 Credits:8 Coefficients : 4	Materials	4	2	1h30	1h30		45h00	55h00	40%	60%
	Organic Chemistry	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological TU Code: MTU 1.4 Credits: 10 Coefficients: 6	PW Thermodynamics – Energetics	2	1			1h30	22h30	22h30	100%	
	Computing and programming	4	2	1h30		1h30	45h00	45h00	40%	60%
	PW Chemistry: thermochemistry -kinetic	3	2			3h00	45h00	45h00	100%	
	PW pharmaceutical Technology	1	1			1h00	15h00	10h00	100%	
Discovery TU Code: DTU 1.4 Credits: 1 Coefficients: 1	Pharmaceutical regulation	1	1	1h30			22h30	02h30		100%
Transversal TU Code: TTU 1.4 Credits: 1 Coefficients: 1	Tutored project 2: Project description and planning (+75 hours of personal work)	1	1	1h30			22h30	02h30		100%
<b>Total semester 4</b>		<b>30</b>	<b>17</b>	<b>12h00</b>	<b>6h00</b>	<b>7h00</b>	<b>375h00</b>	<b>375h00</b>		

**Semester 5**

Teaching unit	Subject	Credits	Coefficient	Teaching hours : per week			Teaching hours : per semester (15 weeks)	Complement ary consulting work (15 weeks)	Evaluation mode	
	entitled			Lecture	T	PW			Continuous control	Exam
<b>Fundamental TU</b> Code: FTU 1.5.1 Credits:10 Coefficients:5	Pharmaceutical Chemistry I: Structure and design conception	6	3	3h00	1h30		67h30	82h30	40%	60%
	Reactors	4	2	1h30	1H30		45h00	55h00	40%	60%
<b>Fundamental TU</b> Code: FTU 1.5.2 Credits:8 Coefficients:4	Drugs analysis and control	2	1	1h30			22h30	27h30		100%
	Biochemistry	4	2	1H30	1H30		45h00	55h00	40%	60%
	PW Material transfer- Unit Operations	2	1	1h30			22h30	27h30		100%
<b>Methodological TU</b> Code: MTU 1.5 Credits: 10 Coefficients:6	PW Material transfer-Unit Operations	2	1			1h30	22h30	22h30	100%	
	PW Drugs analysis and control	2	1			1h30	22h30	22h30	100%	
	PW Reactors	2	1			1h30	22h30	22h30	100%	
	PW Biochemistry	1	1			1H00	15h00	10h00	100%	
	PW Pharmaceutical chemistry I	3	2			3H00	45h00	45h00	100%	
<b>Discovery TU</b> Code: DTU 1.5 Credits:1 Coefficients:1	Biosecurity	1	1	1h30			22h30	02h30		100%
<b>Transversal TU</b> Code: TTU 1.5 Credits:1 Coefficients:1	Expression and communication information Techniques	1	1	1h30			22h30	02h30		100%
<b>Total semester 5</b>		<b>30</b>	<b>17</b>	<b>12h00</b>	<b>4h30</b>	<b>8h30</b>	<b>375h00</b>	<b>375h00</b>		

## Semestre 6

Teaching unit	Subject	Credits	Coefficient	Teaching hours : per week			Teaching hours : per semester (15 weeks))	Complementa ry consulting work (15 weeks))	Evaluation mode	
	entitled			Lecture	T	PW			Continuous control	Exam
Fundamental TU Code: FTU 1.6.1 Credits:10 Coefficients: 5	Pharmaceutical Chemistry II	6	3	3h00	1h30		67h30	82h30	40%	60%
	Separation Techniques and Environment	4	2	1h30	1h30		45h00	55h00	40%	60%
Fundamental TU Code: FTU 1.6.2 Credits:10 Coefficients: 5	Galenic pharmacy	6	3	3h00	1h30		67h30	82h30	40%	60%
	General microbiology	4	2	1h30	1h30		45h00	55h00	40%	60%
Methodological TU Code: MTU 1.6 Credits:8 Coefficients: 5	PW Pharmaceutical Chemistry II	2	1			1h30	22h30	22h30	100%	
	PW Galenic pharmacy	2	1			1h30	22h30	22h30	100%	
	Analysis Techniques	3	2	1h30		1h00	37h30	37h30	40%	60%
	PW microbiology	1	1			1h30	15h00	12h30	100%	
Discovery TU Code: DTU 1.6 Credits:1 Coefficients: 1	Drugs of the future (nano- drugs, personalized medicine, etc.)	1	1	1h30			22h30	2h30		100%
Transversal TU Code: TTU 1.6 Credits:1 Coefficients:1	Business management and Entrepreneurship	1	1	1h30			22h30	2h30		100%
<b>Total semester 6</b>		<b>30</b>	<b>17</b>	<b>13h30</b>	<b>6h00</b>	<b>5h30</b>	<b>375h00</b>	<b>375h00</b>		

## MASTER ENGINEERING OF PHARMACEUTICAL PROCESSES

### Semester 1

Teaching Unit	Subjects	Crédits	Coefficient	Teaching hours : per week			Teaching hours : per semester (15weeks)	Complementary consulting work (15 weeks)	Assessment mode	
	Entitled			Course	Tutorial	PW			Continuous assessment	Exam
<b>Fundamental Teaching Unit</b> Code: FTU 2.1.1 Crédits: 10 Coefficients : 5	General pharmacology	6	3	3h00	1h30		67h30	82h30	40%	60%
	Organic synthesis of drugs	4	2	1h30	1h30		45h00	55h00	40%	60%
<b>Fundamental Teaching Unit</b> Code: FTU 2.1.2 Crédits: 10 Coefficients : 5	Physico-chemical methods of analysis I	4	2	1h30	1h30		45h00	55h00	40%	60%
	Heterogeneous reactors	4	2	1h30	1h30		45h00	55h00	40%	60%
	Pharmacognosy	2	1	1h30			22h30	27h30		100%
<b>Methodological Teaching Unit</b> Code: MTU 2.1 Crédits: 6 Coefficients : 4	PW Heterogeneous reactors	2	1			1h30	22h30	27h30	100%	
	PW Physico-chemical methods of analysis I	3	2			3h00	57h30	27h30	100%	
	PW Organic synthesis of drugs	3	2			3h00	57h30	27h30	100%	
<b>Discovery Teaching Unit</b> Code: DTU 2.1 Crédits: 1 Coefficients : 1	Powder rheology	1	1	1h30			22h30	02h30		100%
<b>Transversal Teaching Unit</b> Code: TTU 2.1 Crédits: 1 Coefficients : 1	English	1	1	1h30			22h30	02h30		100%
<b>Total semester 1</b>		<b>30</b>	<b>17</b>	<b>12h00</b>	<b>7h30</b>	<b>5h00</b>	<b>375h00</b>	<b>375h00</b>		

## Semester 2

Teaching Unit	Subjects	Crédits	Coefficient	Teaching hours : per week			Teaching hours : per semester (15weeks)	Complementary consulting work (15 weeks) lesson	Assessment mode	
	Entitled			Course	Tutorial	PW			Continious assesment	exam
<b>Fundamental Teaching Unit</b> Code: FTU 2.2.1 Crédits: 10 Coefficients : 5	Biochemical and microbiological engineering	6	3	3h00	1h30		67h30	82h30	40%	60%
	Industrial Production of Solid Form Medicines	4	2	1h30	1h30		45h00	55h00	40%	60%
<b>Fundamental Teaching Unit</b> Code: FTU 2.2.2 Crédits: 10 Coefficients : 5	Heat Transfers and Heat Exchangers.	4	2	1h30	1h30		45h00	55h00	40%	60%
	Process management	4	2	1h30	1h30		45h00	55h00	40%	60%
	Galenic pharmacy	2	1	1h30			22h00	27h30		100%
<b>Methodological Teaching Unit</b> Code: MTU 2.2 Crédits: 7 Coefficients : 4	PW Heat Transfers and Heat Exchangers	2	1			1h30	22h30	27h30	100%	
	PW Process management	2	1			1h30	22h30	27h30	100%	
	PW Biochemical and microbiological engineering	2	1			1h30	22h30	27h30	100%	
	Sterilization/Lyophilization	1	1			1h00	15h00	10h00	100%	
<b>Discovery Teaching Unit</b> Code: DTU 2.2 Crédits: 2 Coefficients : 2	Introduction to Chemoinformatics	1	1	1h30			22h30	2h30		100%
	Biopharmacy and Pharmacokinetics	1	1	1h30			22h30	2h30		100%
<b>Transversal Teaching Unit</b> Code: TTU 2.2 Crédits: 1 Coefficients : 1	Compliance with standards and rules of ethics and integrity	1	1	1h30			22h30	2h30		100%
<b>Total semester 2</b>		<b>30</b>	<b>17</b>	<b>13h30</b>	<b>6h00</b>	<b>5h30</b>	<b>375h00</b>	<b>375h00</b>		

## Semester 3

Teaching Unit	Subjects	Crédits	Coefficient	Teaching hours : per week			Teaching hours : per semester (15weeks)	Complementary consulting work (15 weeks) Course	Assessment mode	
	Entitled			Course	Tutorial	PW			Tutorial	Exam
<b>Fundamental Teaching Unit</b> Code : FTU2.3.1 Crédits 10 Coefficients :5	Industrial production of drugs in liquid and paste forms	4	2	1h30	1h30		45h00	55h00	40%	60%
	Biopharmacy and Pharmacokinetics	2	1	1h30			22h30	27h30		100%
	Bioreactors	4	2	1h30	1h30		45h00	55h00	40%	60%
<b>Fundamental Teaching Unit</b> Code : FTU 2.3.2 Crédits : 12 Coefficients : 6	Water production for the pharmaceutical industry	4	2	1h30	1H30		45h00	55h00	40%	60%
	Modélisation et optimisation des procédés	4	2	1h30	1h30		45h00	55h00	40%	60%
	Computer Aided Design (CAD)	4	2	1h30	1h30		45h00	55h00	40%	60%
<b>Methodological Teaching Unit</b> Code : MTU 2.3 Crédits : 6 Coefficients : 4	PW CAD	1	1			1h00	15h00	10h00	100%	
	Process regulation and control	4	2	1h30		1h30	45h00	27h30	40%	60%
	Pharmaceutical Regulations	1	1			1h00	15h00	10h00		
<b>Discovery Teaching Unit</b> Code : DTU 2.3 Crédits : 1 Coefficients : 1	Biosafety and bioethics in the pharmaceutical industry	1	1	1h30			22h30	02h30		100%
<b>Transversal Teaching Unit</b> Code : TTU 2.3 Crédits : 1 Coefficients : 1	Documentary research and dissertation design	1	1	1h30			22h30	02h30		100%
<b>Total semester 3</b>		<b>30</b>	<b>17</b>	<b>13h30</b>	<b>7h30</b>	<b>2h00</b>	<b>375h00</b>	<b>375h00</b>		

**Semester 4**

**Domain** : Sciences and Technologies  
**Sector** : Process Engineering  
**Speciality** : Pharmaceutical Process Engineering

Internship in a company or in a research laboratory sanctioned by a dissertation and a defence.

	THS	Coeff	Credits
Personal work	550	09	18
Internship in a company or in a research laboratory	100	04	06
Seminars	50	02	03
Other (Supervision)	50	02	03
Total Semester 4	750	17	30

**This table is given for information only**

**Master's End of Cycle Project Evaluation**

- Scientific value (Jury's assessment) /6
- Writing of a Master's thesis (Jury's assessment) /4
- Presentation and answering questions (Jury's assessment) /4
- Supervisor's assessment /3
- Presentation of the internship report (Jury's assessment) /3

**II- Semester detailed program**  
**«Licence»**

***Semester 1***

**Semester 1**  
**Subject title : " Mathematics 1"**  
**Code: FTU1.1**  
**THS:67h30(Lecture:3h00, Tutorial:1h30)**  
**Credits:6**  
**Coefficient:3**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject– maximum 3 lines).

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

**Teaching and learning contents:**

**Chapter 1:** Mathematical reasoning Methods

- 1-1 Direct reasoning
- 1-2 Reasoning by contraposition
- 1-3 Reasoning by absurd
- 1-4 counterexample Reasoning
- 1-5 Inductive reasoning

**Chapter 2 :** Sets, relations and applications

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

**Chapter 3 :** Real functions of one real variable

- 3-1 Limit, continuity of a function
- 3-2 Derivative and differentiability of a function

**Chapter 4 :** Elementary functions

- 4-1 Power function
- 4-2 Logarithmic function
- 4-3 Exponential function
- 4-4 Hyperbolic function
- 4-5 Trigonometric function
- 4-6 Inverse function

**Chapter 5 :** Limited development 5-1 Taylor's Formula; 5-2 Limited development: application

**Chapitre 6:** linear algebra

- 6-1 laws and composition
- 6-2 Vector space, basis, dimension
- 6-3 Linear Map, Kernel, Image, Rank

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

**References:** (Books and handouts, websites, etc)

**Semester 1****Subject title:** "Physics1"**Code:** FTU1.1**THS:**67h30(Lecture:3h00, Tutorial:1h30)**Credits:**6**Coefficient:**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject– maximum 3 lines).

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

**Teaching and learning contents :****Reminders in Math:**

1- Dimensional equations

2-Units and vectors

**Chapter I:** Kinematics

1- Position vector in coordinate systems (Cartesian, cylindrical, spherical, curvilinear)- law of movement-Trajectory

2- Velocity and acceleration in coordinate systems.

3-Applications: Movement of the material point in the different coordinate systems.

4- Relative movement

**ChapitreII:** Dynamics

1- Generality: Mass - Force - Moment of force – Absolute and Gallilian repository

2- Newton's laws

3-Principle of conservation of momentum

4- Differential equation movement

5- Kinetic moment

6- Applications of the fundamental law for forces (constant, time dependent, velocity dependent, central force, etc).

**Chapitre III:** Work and energy

1- Work of a force

2- Kinetic Energy

3- Potential energy – Examples of potential energy (gravity, gravitational, elastic)

4- Conservative and non-conservative forces-Total energy theorem

**Assessment mode:** 40% Continuous assessment, 60% Exam**References:** (Books and handouts, websites, etc)

**Semester 1**  
**Subject title : " Structure of Matter "**  
**Code:FTU1.1**  
**THS:67h30(Lecture:3h00, Tutorial:1h30)**  
**Credits: 6**  
**Coefficient:3**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject- maximum 3 lines).

**Prerequisite knowledge** (brief description of the knowledge required to be able to follow this course - Maximum 2 lines).

**Teaching and learning contents :**

**Chapter I : Fundamentals**

Faraday's experiment, physical properties,

Electro: J.J. Thomson's Experiment, Millikan's Experiment

Proton: Goldstein's experiment

Neutron: Chadwick experiment

Presentation and characteristics of the atom (Symbol, atomic number Z, mass number A, number of protons, neutrons and electrons).....

**Chapter III: Radioactivity and nuclear reactions**

**Chapter IV: Electronic Structure of Atoms**

**Chapter V: The periodic classification of the elements**

**Chapter VI: Chemical bonds**

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

**References:** (Books and handouts, websites, etc)

**Semester 1**  
**Subject title: "Physics 1 PW"**  
**Code: MTU1.1**  
**THS: 22h30(PW:1h30)**  
**Credits:2**  
**Coefficient:1**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject– maximum 3 lines).

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

**Teaching and learning contents:**

Handling in the laboratory at least (3H00/ 15 days):

- Methodology of presentation of practical work reports and calculation of errors.
- Verification of Newton's 2nd law
- Free fall
- Simple pendulum
- Elastic collisions
- Inelastic collisions
- Moment of inertia
- Centrifugal force

**Assessment mode:** 100% Continuous assessment

**References:** (Books and handouts, websites, etc)

**Semester 1****Subject title: "Chemistry 1 PW"****Code: MTU1.1****THS: 22h30(PW:1h30)****Credits: 2****Coefficient: 1**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject—maximum 3 lines).

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

**Teaching and learning contents :**

1. Chemical Laboratory Safety and Security
2. Chemical Solutions: Preparation
3. Acid-Base Titrations
4. Iodometry
5. Manganometry
6. Construction of molecular structures

**Assessment mode:** 100% Continuous assessment

**References:** (Books and handouts, websites, etc)

**Semester1**  
**Subject title:"Computer sciences1"**  
**Code:MTU1.1**  
**THS:45h00 (Lecture:1h30, PW:1h30)**  
**Credits:4**  
**Coefficient:2**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject– maximum 3 lines).

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

### **Teaching and learning contents:**

The objective of the subject is to allow students to learn how to program with an advanced language (Fortran, Pascal or C). The choice of language is left to the discretion of each institution.

The notion of algorithm must be implicitly supported during language learning

The main objectif to illustrate the notions taught during the course. The latter must begin with the lessons according to the following schedule:

- PW 1 : familiarization with the computer machine from a hardware and operating systems point of view
- PW 2: introduction to the use of a programming environment (editing, assembly, compilation, etc.)
- PW 3: applications of the programming techniques seen in the course.

**Chapter 1:** introduction to Computing : definitions

**Chapter 2:** Evolution of computing and computers

**Chapter 3 :** Information coding systems

**Chapter 4 :** Principles of Computer Operations

**Chapter 5 :** Hardware part of a computer

**Chapter 6 :** System part: Basic systems (operating systems (Windows, Linux, MacOS, etc.)  
 Programming languages application software.

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

**References:** (Books and handouts, websites, etc)

**Semester 1****Subject title: " Methodology and Scholarly Writing "****Code: MTU 1.1****THS:15h00(lecture: 1h30)****Credits:1****Coefficient:1**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject– maximum 3 lines).

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

**Teaching and learning contents:**

**Chapter 1:** Notions and generalities on writing techniques

**Chapter 2:** Information research, synthesis and exploitation (Library research and website research).

**Chapter 3:** Writing techniques and procedures

**Chapter 4:** Report Writing

**Assessment mode:** 100% Exam

**References:** (Books and handouts, websites, etc)

**Semester: 1**

**Subject title : “Ethical and professional conduct dimension”**

**Code : TTU1.1**

**THS : 22h30 (lecture : 1h30)**

**Credits : 1**

**Coefficient : 1**

**Objectives:**

The main objective of this course is to facilitate an individual's immersion in student life and their transition into a responsible adult. It helps to develop students' awareness of ethical principles. Introduce them to the rules that govern life at the university (their rights and obligations vis-à-vis the university community) and in the world of work, to raise awareness of the respect and enhancement of intellectual property and explain to them the risks of moral evils such as corruption and how to combat them.

**Prerequisite knowledge:** None

**Teaching and learning contents:**

**I. Fundamentals : Définitions**

1. Morals:
2. Ethics:
3. Deontology “Theory of Duty”:
4. The law:
5. Distinction between the different notions

**II. Repositories**

The philosophical references  
 The religious reference  
 The evolution of civilizations  
 The institutional reference

**III. Academic freedom**

Academic freedom concept  
 Regulatory texts (legislation)  
 Academic freedom royalties  
 Academic freedom actors

**IV. Academic values**

Social Values  
 Community Values  
 Professional Values

**V. Rights and obligations**

Student rights; Student obligations Teachers' rights; Obligations of the professor-researcher;  
 Obligations of administrative and technical staff

**VI. Academic relations**

Definition of the concept of academic relations; Student-teacher relationship; Student-student relationship Student - Staff relationship; Student relationship – Association members

**VII. Practices**

Good practices for the teacher

Good practices for the student

**Assessment mode:** 100% Exam

**References:**

1. Collection of ethics and deontology courses of Algerian universities.
2. BARBERI (J.-F.), 'Morale et droit des sociétés', *Les Petites Affiches*, n° 68, 7 juin 1995.
3. J. Russ, *La pensée éthique contemporaine*, Paris, puf, *Que sais-je ?*, 1995.
4. LEGAULT, G. A., *Professionalisme et délibération éthique*, Québec, Presses de l'Université du Québec, 2003.
5. SIROUX, D., 'Deontology', in M. Canto-Sperber (dir.), *Dictionnaire d'éthique et de philosophie morale*, Paris, Quadrige, 2004.
6. Prairat, E. (2009). Les métiers de l'enseignement { l'heure de la déontologie. *Education et Sociétés*, 23.
7. [https://elearning.univ-annaba.dz/pluginfile.php/39773/mod\\_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ontologie.pdf](https://elearning.univ-annaba.dz/pluginfile.php/39773/mod_resource/content/1/Cours%20Ethique%20et%20la%20d%C3%A9ontologie.pdf).

***Semester 2***

**Semester 2**  
**Subject title: "Mathematics2"**  
**Code:FTU1.2**  
**THS:67h30 (Lecture:3h00, Tutorial:1h30)**  
**Credits:6**  
**Coefficient:3**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject—maximum 3 lines).

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

**Teaching and learning contents:**

**Chapter 1:** Matrices and determinants

- 1-1 Matrices (Definition, operation)
- 1-2 Matrix linear application
- 1-3 Change of Basis, transition matrices

**Chapter 2 :** Systems of linear equations

- 2-1 General
- 2-2 Resolution methods for a linear system
  - Resolution by Cramer's method
  - Resolution by the inverse matrix method
  - Resolution by Dauss method

**Chapter 3:** Integrals

- 3-1 Indefinite integral, properties
- 3-2 Integration of rational functions
- 3-3 Integration of exponential and trigonometric functions
- 3-4 Integrating polynomials
- 3-5 Definite Integral

**Chapter 4 :** Differential equations

- 4-1 Ordinary differential equations
- 4-2 First-Order differential equations
- 4-3 Second-Order differential equations
- 4-4 Second order ordinary differential equations with constant coefficient

**Chapter 5:** Functions of several variables

- 5-1 Limit, continuity and partial derivatives of a function
- 5-2 Differentiability
- 5-3 Double and triple integrals

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

**References:** (Books and handouts, websites, etc)

**Semester 2**  
**Subject title: "Physics 2"**  
**Code:FUT1.2**  
**THS:67h30 (Lecture:3h00, Tutorial:1h30)**  
**Credits:6**  
**Coefficient:3**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject—maximum 3 lines).

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

**Teaching and learning contents:**

**Reminders in Math:**

- 1- Elements of length, surface, volume for Cartesian, cylindrical and spherical coordinate systems.
- 2- Multiple derivatives and integrals.

**Chapter 1. Electrostatic**

Electrostatic charges and fields, Electrostatic potential, Electric dipole, Flow of the electric field, Gauss's theorem, Conductors in balance, Electrostatic pressure, Capacitance of a conductor and a capacitor.

**Chapter 2 : Electrokinetics**

Electrical conductor, Ohm's law, Joule's law, Electrical Circuits, Application of Ohm's Law to networks, Laws of Kirchhoff.

**Chapter 3 : Electromagnetism**

Définition d'un champ magnétique, Force de Lorentz, Loi de Laplace, Loi de Faraday, Loi de Biot et Savart, Dipôle magnétique.

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

**References:** (Books and handouts, websites, etc)

**Semester 2**  
**Subject title:"Thermodynamics 2"**  
**Code :FTU1.2**  
**THS:67h30 (Lecture:3h00, Tutorial:1h30)**  
**Credits:6**  
**Coefficient:3**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject– maximum 3 lines).

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

### **Teaching and learning contents :**

#### **Chapter 1:** Basic Concepts of Thermodynamics

Review the metric SI, Explain the basic concepts of thermodynamics such as system, state, state postulate, properties of a system, equilibrium, fundamental laws, process, and cycle.

#### **Chapter 2 :** Temperature and Heat

Notion of temperature: Thermometry, The zero principle of thermodynamics, Temperature scales, Design of a thermometer, The different types of thermometers.

Concept of heat or quantity of heat Q: General expression of heat quantity, calorimetry , specific heat capacity.

#### **Chapter 3 :** The first law of thermodynamics

Define the first law of thermodynamics, Describe how conservation of energy relates to the first law of thermodynamics, Demonstrate the understanding of internal energy concepts and its relationship to heat and work.

#### **Chapter 4 :** Applications of First Law of Thermodynamics to thermochemistry

Heats of reaction:  $QR, QP, QV$ , The standard state, The standard enthalpy of formation  $\Delta H^\circ f$ , The enthalpy of dissociation, The enthalpy of change of physical state ( $\Delta H_{fus}, \Delta H_{vap}, \Delta H_{sub}$ ), The enthalpy of a chemical reaction  $\Delta H_R$ , Law of Hess, Bond energy or bond enthalpy, Reticular energy (Born-Haber cycle), The enthalpy of formation of gaseous atoms  $\Delta H_f(\text{atoms, gaseous})$ , Kirchoff's law and.....

#### **Chapter 5 :** 2nd law of thermodynamics

Application of the concept of entropy

#### **Chapter 6 :** The Third Law of Thermodynamics

Statement of the 3rd Principle, absolute entropy, the standard molar absolute entropy of a pure body  $S_0$ ,  $S_T$  standard molar absolute entropy at  $T$  Kelvin (TK) 298, The standard molar absolute entropy of a pure (solid, liquid, gas), The entropy variation of a chemical reaction  $\Delta S_R$ , The entropy variation of a chemical reaction  $T$ .

**Chapter 7 : Free energy and enthalpy – criteria for evaluating a system**

Introduction, Energy and free enthalpy, Chemical equilibriums, Laws of mass action and equilibrium constants, Guldberg and Waage relation for homogeneous equilibria, Influence of temperature on equilibrium constants: VANT'HOFF relationship, Equilibrium Displacement Laws, Complementary aspect of the study of equilibriums, Dissociation coefficient or degree of dissociation  $\alpha$ , Degree of advancement of a chemical reaction, The yield of a chemical reaction, Variance of a system in equilibrium and phase rules.

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

**References:** (Books and handouts, websites, etc)

**Semester 2**  
**Subject title: "Physics 2 PW"**  
**Code: MTU1.2**  
**THS: 22h30(PW:1h30)**  
**Credits: 2**  
**Coefficient: 1**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject—maximum 3 lines).

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

**Teaching and learning contents :**

Handling in the laboratory at least (3H00/ 15 days):

- Presentation of measuring instruments (Voltmeter, ammeter, rheostat, oscilloscopes, generator,...etc).
  - Equipotential surfaces in electrostatics.
  - Association and Measurement of resistances
  - Association and Measurement of capacities
  - Voltage and current dividers
  - Capacitor Charging & Discharging
  - Oscilloscope
  - Practical work on magnetism Ideal Gas Equation: The gaseous system,
2. 1. Verification of the three empirical laws (Laws of Boyle-Mariotte, Gay Lussac, Charles-Amontons).
  3. 2. Determination of the mass capacity of solids
  4. 3. Determination of the mechanical equivalent of heat (J)
  5. 4. Application of the first principle of thermodynamics Determination of the energy released by a chemical reaction
  6. (HCl/NaOH)
  7. 5. The heat pump (inverse Carnot cycle)

**Assessment mode:** 100% Continuous assessment

**References:** (Books and handouts, websites, etc)

**Semester 2**  
**Subject title: "Computer sciences2"**  
**Code:MTU1.2**  
**THS:37h30 (Lecture:1h30, PW:1h00)**  
**Credits:3**  
**Coefficient:2**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject- maximum 3 lines).

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

**Teaching and learning contents :**

**Chapter 1:** Functions and procedures

- 1- Functions: Types of functions, Declaration of functions, Calls of functions
- 2- Procedures: Notions of global variables and local variables, Simple procedure, Procedure with arguments

**Chapter 2:** Records and files

- 1- Structure of heterogeneous data
- 2- Structure of a record (concept of fields)
- 3- Manipulation of record structures
- 4- Notion of file
- 5- File access modes
- 6- Reading and writing to a file

**Chapter 3:** Advanced concepts

- 1- Recursion
- 2- Modular programming
- 3- The graphics
- 4- Pointers

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

**References:** (Books and handouts, websites, etc)

**Semester 2**  
**Subject title: " Presentation methodology "**  
**Code: MTU1.2**  
**THS: 22h30(Lecture: 1h30)**  
**Credits:2**  
**Coefficient:1**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject- maximum 3 lines).

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

**Teaching and learning contents :**

Part I: Oral Expression Techniques

- Gestures and attitude to adopt in front of an audience

Part II: Preparation of an oral presentation

- the supports of a presentation: software and audiovisual materials

- Application: presentations (report, report, project, etc.)

**Assessment mode:** 100% Exam

**References:** (Books and handouts, websites etc)

***Semester 3***

**Semester 3**  
**Subject title: " Fluid mechanics "**  
**Code: FTU1.3.1**  
**THS: 67h30 (Tecture: 3h00, Tutorial: 1h30)**  
**Credits: 6**  
**Coefficient: 3**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject– maximum 3 lines).

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

**Teaching and learning contents :**

**Fluid mechanics :**

- Characterization (density, viscosity, surface and interfacial tension).
- Fluid statics, pressure and level measurement.
- Dynamics of perfect fluids, Bernoulli's theorem.
- Dimensional analysis-dimensionless numbers (Reynolds,...).
- Dynamics of real Newtonian fluids, flow regimes, pressure drop.
- Measurement of flow rates and fluid velocities.
- Notions on non-Newtonian fluids
- Power to be implemented to circulate a fluid in an installation.

Network curve.

- Pumps: total manometric head, absorbed power, efficiency, net suction head (NPSH), characteristic curves, operating point, coupling.
- Vacuum: units of measurement, limits, pumping speeds, vacuum pump, measuring devices.

**Fluid transport technology**

- Sealing devices, pipes and fittings: standardization.
- Valves and measuring devices (flow rate, pressure).
- Pipe sizing.
- Devices for moving fluids: pumps, fans, vacuum pump.
- Technical study of installation elements: pumps, valves.

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

**References:** (Books and handouts, websites, etc)

**Semester 3**  
**Subject title: " Balances - Initiation to unit operations"**  
**Code:FTU1.3.1**  
**THS:45h00 (Lecture:1h30, Tutorial:1h30)**  
**Credits:4**  
**Coefficient:2**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject- maximum 3 lines).

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

**Teaching and learning contents :**

- Phase diagram
- Characterization of a mixture
- Unit operations (physical, chemical transformations, etc.)
- Concept of balance
- Determination of the enthalpy of a liquid, a vapor, liquid-vapor mixtures
- Establishment of a balance:
  - - Notion of extensive and intensive magnitude
  - - Balance in steady state without chemical reaction
  - - Balance sheet with chemical reaction
  - - Balance sheet with recycling
  - - Notion of accumulation, notion of differential balance sheets
  - - Application to material balances
  - - Application to energy balances
- Balance on a unit operation (evaporator, crystallizer, dryer, etc.)

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

**References:** (Books and handouts, websites, etc)

**Semester 3****Subject title: " Chemical equilibria "****Code:FTU1.3.2****THS:67h30 (Lecture:3h00, Tutorial:1h30)****Credits:6****Coefficient:3**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject- maximum 3 lines).

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

**Teaching and learning contents :****Structure of matter**

- The atom
- The periodic table
- The molecule
- Chemical bonds and interaction

**Equilibria in aqueous solution**

- General qualitative and quantitative laws
- Acid-base Equilibriums
- Equilibriums precipitation
- Redox Equilibriums
- Complexation Equilibriums

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

**References:** (Books and handouts, websites, etc)

**Semester 3**  
**Subject title: " Surface chemistry "**  
**Code: FTU1.3.2**  
**THS: 45h00 (Lecture: 1h30, Tutorial: 1h30)**  
**Credits: 4**  
**Coefficient: 2**

**Teaching objectives:** Surface treatments find their importance through the various aspects of reality that they cover: economic aspects in the problems of durability and corrosion, commercial aspects by the aesthetic improvement of surfaces, technological aspects by the improvement of the mechanical properties (hardness, adhesion) or of certain particular properties.

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

**Teaching and learning contents:**

- Tensionactivity: Molecular phenomena that occur at liquid-air, liquid-liquid, solid-gas and solid-liquid interfaces Surface tension, surface thermodynamic functions, curve interfaces, capillarity, methods of calculating surface tension.
- Physico-chemistry of surfaces: phenomena of adhesion, cohesion, debridement and flotation.
- Adsorption of liquids: surfaces of aqueous solutions (dilute and concentrated solutions), Gibbs isotherms.
- Adsorption of gases: heat of adsorption, physisorption, chemisorption, isotherm of adsorption, Langmuir theory, BET theory, specific surface, porosity.
- Heterogeneous catalysis.

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

**References:** (Books and handouts, websites, etc)

**Semester 3**  
**Subject title:" Fluid mechanics PW"**  
**Code:MTU1.3**  
**THS: 22h30(PW:1h30)**  
**Credits:2**  
**Coefficient:1**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject– maximum 3 lines).

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

**Teaching and learning contents :**

- Measurement of thermo-physical properties: viscosity, density, surface tension....
- Flow regimes.
- Pressure drop measurements.
- Flow and pressure measurements.
- Disassembly and reassembly of installation elements: taps, valves, pump.
- Study of a centrifugal pump and couplings.
- Study of a fan.

**Assessment mode:** 100% Continuous assessment

**References:** (Books and handouts, websites, etc)

**Semester 3**  
**Subject title: " Chemical equilibria PW"**  
**Code: MTU1.3**  
**THS: 22h30(PW:1h30)**  
**Credits:2**  
**Coefficient:1**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject- maximum 3 lines).

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

**Teaching and learning contents :**

**Volumetric dosing**

- Acid-bases
- Oxidation-reduction
- Complexometric
- Gravimetric

**pH-metry, potentiometry**

**Assessment mode:** 100% Continuous assessment

**References:** (Books and handouts, websites, etc)

**Semester 3**  
**Subject title: " Surface chemistry PW"**  
**Code: MTU1.3**  
**THS: 22h30(PW:1h30)**  
**Credits: 2**  
**Coefficient: 1**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject- maximum 3 lines).

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

**Teaching and learning contents:**

- PW1. Measurement of the surface tension of organic liquids
- PW2. Physico-chemical study of the tensio activity
- PW3. Determination of the critical micellar concentration
- PW4. Study of the kinetics of adsorption of acetic acid by activated carbon
- PW5. Adsorption kinetics Modeling

**Assessment mode:** 100% Continuous assessment

**References:** (Books and handouts, websites, etc)

**Semester 3****Subject title: " Computer and scientific tools "****Code: TTU1.3****THS: 22h30 (Lecture: 1h30)****Credits: 1****Coefficient: 1**

**Objectives** (Describe what skills the student is supposed to have acquired after passing this subject—maximum 3 lines).

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

**Teaching and learning contents :****Chapter 1:** Solving nonlinear equations  $f(x)=0$ 

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

**Chapter 2:** Polynomial Interpolation

General introduction, Lagrange polynomial, Newton polynomials.

**Chapter 3:** Function Approximation:

Approximation method and quadratic mean, Orthogonal or pseudo-Orthogonal systems, Approximation by orthogonal polynomials, Trigonometric approximation.

**Chapter 4: Digital Integration**

General introduction, Trapezium method, Simpson's method, Quadrature formulas.

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

General introduction, Euler method, Improved Euler method, Runge-Kutta method.

**Chapter 6:** Method of direct solution of systems of linear equations

Introduction and definitions, Gaussian method and pivoting, LU factorization method, Choleski MMT factorization method, Thomas algorithm (TDMA) for tridiagonal systems.

**Chapter 7:** Approximate Solving Method for Systems of Linear Equations

Introduction and definitions, Jacobi method, Gauss-Seidel method, Use of relaxation.

**Assessment mode:** 100% Exam

**References:** (Books and handouts, websites, etc)

*Semester 4*

**Semester 4**  
**Subject title: "Thermodynamics - Energetics"**  
**Code: F1.4.1**  
**SHV: 45h00 (course: 1h30, T: 1h30)**  
**Credits:4**  
**Coefficient:2**

*Teaching objectives: master the basic concepts of phenomenological thermodynamics and the operating principle of certain energy technologies. Recommended prior knowledge (brief description of the knowledge required to be able to follow this course – Maximum 2 lines).*

*Content of the subject:*

### **Thermodynamics**

- Generalities and fundamental principles
- First principle: closed systems – balances of extensive graders – open systems, permanent energy – calorimetry, specific heats – thermodynamic properties of matter.
- Particular thermodynamic transformations (isothermal, isochoric, isobaric and adiabatic)
- Ideal gas, real gas
- Joule and Gay-Lussac and Joule-Kelvin relaxation
- Phase change of pure substances – equilibrium of a substance for two phases – latent heat of phase change – Clapeyron equation.
- Second principle: entropy –Notion of thermal source –Application to a thermodynamic cycle– Variation of entropy of a simple system–Compression and isentropic and polytropic expansions.
- Thermodynamic diagram: Clapeyron, Mollier, entropic, refrigeration engineers.
- Thermal machines: (driving and receiving), thermodynamic cycles.

### **Energy technology**

- Single and multi-stage centrifugal, volumetric compressors.
- Vapor compression and absorption refrigeration, heat pump.
- Steam turbine, gas.
- Cogeneration plant.
- Boiler.
- Liquefiers, use and storage of liquefied gases..

### **Evaluation mode :**

Continuous assessment : 40%; Exam:60%.

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

**Semester 4**  
**Subject title: "PW Thermodynamics - Energetics"**  
**Code: M1.4**  
**HVS: 22h30(PW:1h30)**  
**Credits:2**  
**Coefficient:1**

**Teaching objectives:** Apply the fundamental principles of phenomenological thermodynamics to calorimetric liquid-vapor equilibrium measurements and energy technologies.

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

*Content of the subject:*

- *Study of volumetric compressors*
- *Study of thermodynamic cycles: vapor compression and absorption refrigeration, heat pump, gas and steam turbines.*
- *Calorimetry: measurement of latent heat of vaporization, specific heats.*
- *Ebulliometry: liquid-vapor equilibrium of a simple body.*
- *Simulation of thermodynamic cycles.*

**Evaluation mode:**

Continuous assessment : 100%; Exam: 00%.

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

**Semester 4**  
**Subject title: " Chemistry: thermochemistry -kinetic"**  
**Code:F1.4.2**  
**HVS:45h00 (Course:1h30, T:1h30)**  
**Credits:4**  
**Coefficient:2**

**Teaching objectives:** master the fundamental notions of chemical thermodynamics and chemical kinetics

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

*Content of the subject:*

#### **Chemical thermodynamics**

- The principles of thermodynamics (first and second principle, quantity of heat, work, Joule's law, Mayer's relation,...).
- - Thermochemistry: determination of heats of reaction, bond enthalpies, reticular energy, electron affinity, ionization potential,...
- - Free enthalpy-free energy.
- - Study of equilibriums: equilibrium constant, equilibrium displacement law, variance.
- -

#### **Chemical kinetics**

- - Reaction rate, order and molecularity, simple reactions, complex reactions.
- - Speed measurement.
- - Simple order study.
- - Experimental determination of order of a reaction.
- - Activation energy.
- - Reaction mechanism
- - Homogeneous catalysis, heterogeneous-photochemical activation.

#### **Evaluation mode :**

Continuons assessment:40%; e Exam:60%.

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

**Semester 4**  
**Subject title: "PW Chemistry: thermochemistry - kinetic"**  
**Code: M1.4**  
**HVS: 22h30(PW:1h30)**  
**Credits:2**  
**Coefficient:1**

**Teaching objectives:** master the experimental methodology in chemical kinetics and thermodynamics

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

**Content of the subject:**

- Chemical kinetics in the liquid phase (determination of the rate constant of a reaction {different temperatures, activation energy, etc...})
- Chemical kinetics in the gaseous phase.
- Study of a closed adiabatic reactor (determination of the water equivalent of the calorimeter, of the enthalpies of reaction, comparison with the values of thermodynamic tables,)

**Evaluation mode :**

Continuons assessment : 100%; Exam: 00%.

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

**Semester 4**  
**Subject title: " organic chemistry"**  
**Code: F1.4.2**  
**HVS: 45h00 (Course: 1h30, T: 1h30)**  
**Credits: 4**  
**Coefficient: 2**

**Teaching objectives:** master the fundamental notions in organic

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

*Content of the subject:*

- Nomenclature
- Stereochemistry (conformation and configuration stereoisomers)
- Inductive and mesomeric effects
- Presentation of the main families of reactions in organic chemistry
- Study of the main families of organic compounds and their reactivity:
  - alkanes
  - alkenes
  - halogenated derivatives
  - alcohols
  - carbonyl compounds
  - amines

**Evaluation mode :**

Continuons assessment : 40%; Exam: 60%.

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

**Semester 4**  
**Subject title: "PW organic chemistry"**  
**Code: M1.4**  
**HVS: 22h30(PW:1h30)**  
**Credits:2**  
**Coefficient:1**

**Teaching objectives:** to master the experimental methodology in organic chemistry **Recommended prior knowledge** ((brief description of the knowledge required to be able to follow this course – Maximum 2 lines).

**Content of the subject**

- Basic techniques in organic chemistry
- Introduction to synthesis and control

**Evaluation mode:**

Continuous assessment: 100%; Exam: 00%.

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

**Semester 4**  
**Subject title:" Materials"**  
**Code: F1.4.2**  
**HVS S: 45h00 (Course: 1h30, T: 1h30)**  
**Crédits:4**  
**Coefficient:2**

**Teaching objectives:** to know the properties of materials and the characteristics specific to their use

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

### **Content of the subject**

- **Materials**
- Material characteristics:
- Notions on metals and alloys, plastics, composite materials.
- Designation of materials, standardization.
- Notions on the treatment of materials.
- Strength of materials:
- Simple problems in tension, compression, shear.
- Calculation of wall thickness of pressure and vacuum devices.
- Regulation and control of pressure vessels.
- **Corrosion**
- Various types of corrosion.
- Materials choice.
- Protection against corrosion

### **Evaluation mode :**

Continuous assessment: 100%; Exam: 00%.

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

**Semester 4**  
**Subject Title:"Pharmaceutical Technologies"**  
**Code:F1.4.2**  
**HVS:22h30 (Course:1h30)**  
**Credits:2**  
**Coefficient:1**

**Teaching objectives:** The pharmaceutical technologies module introduces students to fundamental concepts in the field of pharmaceuticals, the classification of excipients used in pharmacy, and knowledge of the various pharmaceutical technologies.

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

#### **Content of the subject**

- **CHAPTER I**
- Drugs and non-drugs, Origins and classification of drugs, Pharmaceutical forms and routes of administration.
- CHAPTERII: Production regulations in the pharmaceutical industry
- Administrative circuit of the medicinal product, Application for marketing authorization II, Criteria used for awarding the price
- **CHAPTERIII: Excipients Water, other liquid excipients, Glycerides, sugars, sugar derivatives and hydrophilic macromolecules, Cellulose and its derivatives, Surfactants**
- **CHAPTERIV: Technologies of pharmaceutical preparations**
- Crushing and screening of solid bodies, Separation of solid and liquid bodies, Drying, Sterilization
- **CHAPTERV: Extraction**
- The extraction and the factors influencing the extraction process, Infusions, types of infusions and herbal teas
- 
- **CHAPTERVI: Extracts**
- Extracts, liquid and thick extracts, Technology of liquid and thick extracts
- CHAPTER VII: Preparations from fresh plants and phytocides
- Preparations of vitamins, ferments, medicinal oils, syrups, flavored waters and medical soaps

#### **Evaluation mode:**

Continuous assesment : 00%; Exam: 100%.

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

**Semester 4**  
**Subject Title: "Tutored project 2: Project description and planning"**  
**Code: T1.4**  
**HVS:22h30(Course: 1h30)**  
**Credits:1**  
**Coefficient:1**

**Teaching Objectives:** to learn about project management methods.

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

**Content of the subject**

- The project must have a realistic scope to implement all the activities, tasks and constraints of conducting an industrial or service project, {namely:
- - Drafting of specifications
- - Building a team
- - Distribution and planning of tasks
- - Time and deadline management
- - Search for constraints
- - Documentation, dissertation and oral presentation
- -

**Specialty-specific content:** documentary research, analysis of specialized technical documentation in process engineering, chemistry, bioprocesses, analysis of installation diagrams, consideration of safety constraints

**Evaluation mode**

Continuous assessment : 00%; Exam: 100%.

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

***Semester 5***

**Semestre 5**  
**Subject Title: "Pharmaceutical Chemistry I"**  
**Code: F1.5.1**  
**HVS: 45h00 (lesson: 1h30, T: 1h30)**  
**Credits:4**  
**Coefficient:2**

*Teaching objectives: Deepening of the basic notions of chemistry. Extension of these notions to the fundamental chemical principles governing drug behavior in the body. This course is a link between organic and pharmaceutical chemistry.*

*Recommended prior knowledge: Basic notions of general chemistry and organic chemistry.*

### Content of the subject

- **Chap.1. Consolidation of basic notions of chemical bonding (4 weeks)** Atoms and interatomic cohesion forces, some modern aspects of chemical bonding: from Lewis to molecular orbitals, Weak intermolecular forces. Illustration of the nature of forces.
- 
- **Chap2. Heteroaromatics (4 weeks)**
  - Notion of aromaticity, Huckel's rule
  - Illustrations of some access routes: Case of aromatic heterocycles with 5 members (thiophene, pyrrole, furan) and 6 members (pyridine, quinoline, isoquinoline)
  - Common access routes and reactivities, SE, SNAr
  - Some cases of polyhetero atomic hetero atoms.
- 
- **Chap.3. Notions of dynamic stereochemistry (4 weeks)**
  - General (Elements of dynamic stereochemistry, Curtin-Hammet principle) The different types of stereochemical inversion (Racemization, Epimerization)
  - Notions of stereoselective and stereospecific reactions Asymmetric synthesis, asymmetric induction
  - i) From chiral molecules (hemisynthesis),
  - ii) Using a chiral auxiliary,
  - iii) Using a chiral reagent,
  - iv) By enantio-selective catalysis.
- 
- **Chap.4 Introduction to therapeutic chemistry (3 weeks)**
  - i) Fundamental principles of drug design,
  - ii) structure-activity relationships and those between structure and physicochemical properties,
  - iii) drug-target interactions including thermodynamic and kinetic concepts of binding and
  - iv) Drug metabolism.

**Evaluation mode:**

Continuous assessment: 00%; Exam: 100%.

*References*

- 1- K. Peter C. Vollhardt, Neil E. Schore: Organic Chemistry, 4ème Edition, Freeman and Co 2003.
- 2- Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers: Organic Chemistry, Oxford University Press 2001.
- 3- Graham L. Patrick: An introduction to Medicinal Chemistry, 2ème Edition, Oxford University Press 2001 - Wermuth C.: The Practice of Medicinal Chemistry, Academic Press, 2e Ed- 2003, 3e Ed 2008.
- 4- G. Thomas: Medicinal Chemistry - An introduction, 2e Ed- 2008. 4- Williams DA, Foye WO, Lemke TL: Foye's Principles of Medicinal Chemistry, Lippincott Williams & Wilkins, 2002.
- 5- 5- Patrick GL: An Introduction to Medicinal Chemistry, Oxford University Press, 3e Ed- 2005

**Semestre 5****Subject Title: "PW Pharmaceutical Chemistry I "****Code: M1.5****HVS: 22h30(PW:1h30)****Crédits: 2****Coefficient: 1**

**Teaching objectives:** To familiarize the student with the methods of synthesis at the laboratory scale and also to know the principles of purifications and separations after isolation of the prepared compounds.

**Recommended prior knowledge:** Principles of organic chemistry and pharmaceutical chemistry, and separation methods in general

**Content of the subject**

TP1: Learning separation methods (Liquid-liquid extraction, fractional distillation),

TP 2: Learning purification methods (r Recrystallization, distillation),

TP3: Learning characterization methods (melting and boiling points, refractive index, chromatography),

TP4: Learning structural identification methods (NMR and IR spectroscopy, chemical tests).

TP5: Introduction to functional analysis and synthesis.

NB: These techniques are implemented using aromatic compounds

**Evaluation mode :**

Continuous assessment: 100%; Exam: 00%.

*References*

1. aniel R. Palleros: Experimental Organic Chemistry John Wiley and Sons 2000
2. Donald L. Pavia et al: Introduction to Organic Laboratory Techniques, 4<sup>e</sup> Edition, Brooks/Cole 2007
3. Shriner, Hermann, Morrill, Curtin, Fuson: The Systematic Identification of Organic Compounds, 7<sup>e</sup> Edition, Wiley and Sons 1998
4. Graham L. Patrick: An introduction to Medicinal Chemistry, 2<sup>e</sup>me Edition, Oxford University Press 2001

**Semestre 5**  
**Subject Title: "Reactors"**  
**Code: F1.5.1**  
**HVS: 45h00 (lesson : 1h30, T:1h30)**  
**Credits:4**  
**Coefficient:2**

**Teaching objectives:** to master the fundamental notions of agitation-mixing, to understand reactions and reactors, to master the writing and resolution of material and thermal balances in order to ensure adequate sizing and operation of industrial reactors..

**Recommended prior knowledge:** Principles of organic chemistry and pharmaceutical chemistry, and separation methods in general

### **Content of the subject**

#### **Chemical reactors**

- Continuous reactors, discontinuous reactors
- Perfectly stirred reactors, piston reactor
- Association of reactors
- Influence of physical factors (pressure, temperature, etc.)
- Material and heat balances
- Sizing of reactors
- Consideration of security constraints
- Notions of residence time distribution

#### **Reactor technology**

- Different types of reactors: tubular, stirred mechanical stirring
- Various agitation systems and selection criteria
- Power consumption, pumping and circulation rates
- Power number, Reynolds number
- Notion of mixing, suspension of a solid, gas-liquid, liquid-liquid system
- Heat transfer

#### **Evaluation mode :**

- Continuous assesment: 40%; exam :60%.
- References (Books and handouts, websites, etc.)

**Semester 5**  
**Subject title: "PW Reactors"**  
**Code: M1.5**  
**HVS: 22h30(PW 1h30)**  
**Crédits:2**  
**Coefficient:1**

**Teaching objectives:**

Put into practice the fundamental notions of agitation-mixing, understand reactions and reactors, master the writing and resolution of material and thermal balances in order to ensure adequate operation of industrial reactors.

**Recommended prior knowledge:** Principles of organic chemistry and pharmaceutical chemistry, and separation methods in general

**Evaluation mode :**

Continuous assesment : 100%; Exam: 00%.

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

**Semester 5**  
**Subject title: "Drug Analysis and Control"**  
**Code: F1.5.1**  
**HVS: 22h30 (Cours: 1h30)**  
**Credits: 2**  
**Coefficient: 1**

**Teaching objectives:** Master the methods of analysis for the control of medicines

**Recommended prior knowledge** (succinct description of the knowledge required to be able to follow this course - Maximum 2 lines).

## Content of the subject

### Chapter 1

General framework for the analysis and control of medicines Definitions of basic concepts (medicine, analysis, control, counterfeit medicines, quality, stability of medicines); Main sources of contamination or alteration of medicines; Main standards (pharmacopoeias, ICH guidelines, GMPs) ; General organization of drug control systems (national and international actors, challenges posed by international trade and counterfeit drugs, etc.); Examples of monographs of active ingredients.

### Chapter 2:

Main elements of an analytical strategy Characterization of an analysis problem (questions {to be asked in order to design an analysis strategy, aspects related to the type of drug (complex mixtures, synthetic PA, etc.), aspects related to sampling, etc.); Analyzing the performance of an analytical technique; Analytical purposes in the pharmaceutical field (identification, dosage, search for impurities) ; Analytical approach for the identification of a pharmaceutical substance (organoleptic analysis, physico-chemical constants (temperatures of change of physical state (melting/boiling point...), solubility, optical rotation, chemical indices, refractive index..... ); analytical approach for the dosage of a pharmaceutical substance (pure substances, complex mixtures, etc.) ; Analytical approach for the search for impurities (main types of impurities, raw materials, finished product)

### Chapter3:

Introduction to the main categories of analysis techniques Reminders of chromatographic techniques; Reminders of spectral techniques (IR, UV-Vis, mass spectrometry, atomic absorption); Spectral techniques (NMR, tandem mass spectrometry (MS MS), plasma mass spectrometry at inductive coupling (ICP- MS), Raman spectroscopy....); Classical titrimetric techniques (titration by precipitation (argentometry or argentometry), acid-base titration (protometry in aqueous and non-aqueous media), titration by formation of complexes (complexometry), titration by oxidation-reduction reactions (electrochemical methods))

### Chapter4:

Drug quality control testing: identification testing, stability testing, dosage form quality control testing, microbiological quality control testing, specific testing for biotech drugs, sterile drugs and chiral drugs, Controls of packaging materials: Tests of packaging materials (identification, mechanical tests, chemical resistance tests, transparency tests, permeability tests, conservation tests, innocuousness tests).

**Chapter 5:** Basic notions of the pharmaceutical quality system, risk management, quality by design (ICH regulatory requirements), Validation of analysis methods and qualification of equipment, constitution of the MA application file

*Evaluation Mode:*

Continuous assesment : 00%; Exam: 100%.

*References*

1. Tranchant, Manuel pratique de chromatographie en phase gazeuse, Masson, Paris 1995.
2. Méthodes et techniques instrumentales modernes, F. Rouessac et A. Rouessac, Dunod, Paris 2004
3. Principes d'analyse instrumentale, Douglas Arvid Skoog, F. James Holler, Timothy A. Nieman
4. Analyse pratique du médicament, Dominique Pradeau

**Semester 5**  
**Subject title: " PW Drug Analysis and Control"**  
**Code: M1.5.1**  
**HVS: 22h30(PW:1h30)**  
**Credits: 2**  
**Coefficient: 1**

**Teaching objectives: Master the methods and analysis techniques for the control of drugs**

**Recommended prior knowledge** (succinct description of the knowledge required to be able to follow this course  
- Maximum 2 lines).

**Content of the subject**

- Dosage of aspirin by UV spectroscopy
- Dosage of barbiturates and their identification by IR
- Non-aqueous trimebutine assay (weak base)
- Identification of some antacids (acedrine, ranitidine)
- Analysis of purine group alkaloids
- Analysis of anti-inflammatory (ibuprofen)

**Evaluation mode :**

Continuous assesment: 100%; Exam: 00%.

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

**Semester 5**  
**Subject title: "Biochemistry"**  
**Code: F1.5.2**  
**HVS:22h30(lesson : 1h30)**  
**Credits:2**  
**Coefficient:1**

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

### **Content of the subject**

- **Chapter I: Amino acids**
- Definition, Classification, Stereochemistry and optical properties of amino acids, Spectral properties, Acid-base properties of amino acids, Chemical properties, Methods of separation of an amino acid mixture
- **Chapter II: Proteins**
- Definition, Structures, Structure/Function Relationship, Physicochemical Properties, Protein Separation Techniques
- **Chapter III: Enzymes**  
Definition, Structure, Properties of Enzymes, Classification, Kinetics of Michaelian Enzymes, Allosteric Enzymes
- **Chapter IV: Lipids**
- Definition, Fatty Acids, Chemical Properties of Fatty Acids, Lipids, Chemical Properties of Complex Lipids:
- **Chapter V: Carbohydrates**
- Definition, Biological roles, Classification, Monosaccharides, Physical properties of monosaccharides, Properties, Oligosides, Polyosides.
- **Chapter IV: Nucleic acids:**
- Purine and pyrimidine bases, Nucleosides, Nucleotides, Oligonucleotides, polynucleotides:

### **Evaluation mode :**

Continuous assesment: 00%; Exam: 100%.

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

**Semester 5**  
**Subject title "PW Biochemistry"**  
**Code: M1.5**  
**HVS: 15h00(PW: 1h00)**  
**Credits:1**  
**Coefficient:1**

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

**Content of the subject**

- Determination of the optical rotation of sugars
- Dosage of carbohydrates (glucose, fructose or lactose).
- Fat indices.
- Potentiometric dosage of an amino acid: example: glycine.
- Separation of amino acids by TLC.
- Protein assay methods.
- Electrophoretic separation of proteins.
- Demonstration and measurement of enzymatic activity: example study of catalase activity,
- Dosage of vitamin C.

**Evaluation mode :**

Continuous assesment : 100%; Exam: 00%.

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

**Semestre 5**  
**Subject title " Material transfer - Unit operations "**  
**Code:F1.5.2**  
**HVS:22h30(lesson: 1h30)**  
**Credits:2**  
**Coefficient:1**

**Recommended prior knowledge** (succinct description of the knowledge required to be able to follow this course - Maximum 2 lines).

### **Content of the subject**

#### Balance between phases

- Pure body, variance, phase rule
- Liquid-liquid balance
- Liquid-vapor equilibrium
- Liquid-solid balance
- Material balance – unit operations
- Theoretical floor, real floor
- Cascade of theoretical stages, number of theoretical stages, graphical and numerical calculation.
- 

#### Method, material and energy balances

- Liquid-liquid extraction
- Crystallization Distillation
- Distillation of a binary mixture: method of Mac and Thiele and Ponchon Savarit
- Notions of distillation of azeotropes.
- 

#### Material transfer technology

- Crystallizers
- Liquid-to-liquid extractors

#### **Evaluation mode :**

Continuous assesment: 00%; Exam:100%.

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

**Semester 5**  
**Subject title: "PW Material transfer - Unit operations"**  
**Code: M1.5**  
**HVS: 22h30(PW:1h30)**  
**Credits:2**  
**Coefficient:1**

**Teaching objectives:** To apply notions relating to unit operations in process engineering at the level of phase equilibria, balances and transfers of materials.

**Recommended prior knowledge** (succinct description of the knowledge required to be able to follow this course - Maximum 2 lines).

### **Content of the subject**

- Liquid-liquid, liquid-vapor, liquid-solid equilibriums
- Continuous and discontinuous distillation
- Liquid-liquid extractions
- crystallization

### **Evaluation mode :**

Continuous assesment : 100%; Exam: 00%.

**References** (Books and handouts, websites, etc

**Semester:4**

**Subject title : Techniques of expression, information and communication..**

**Code 1.5**

**HVS:22h30 (lesson: 1h30)**

**Credits:1**

Teaching objectives:

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

Recommended prior knowledge:

Languages (Arabic; French; English)

**Content of the subject:**

**Chapter 1:** Researching, analyzing and organizing information (2 weeks) Identifying and using places, tools and documentary resources, Understanding and analyzing documents, Compiling and updating documentation.

**Chapter 2:** Improving the capacity for expression (2 weeks)

Take into account the Communication situation, Produce a written message, Communicate orally, Produce a visual and audiovisual message, Improve group communication skills.

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

Position yourself in a project and communication approach, Anticipate action, Implement a project:

Presentation of a report of practical work (Duty {home}).

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

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

Search directories (YAHOO, GOOGLE), Search engines, Query and search language, Retrieving and printing an HTML page, Retrieving an image, Downloading a file or software, Playing an HTML file locally, Playing a multimedia file saved on the Web.

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

Computer crime, Media law, Electronic communications law, E-commerce law, Internet governance, ...

**Chapter 7:** Securing Sensitive Information, Protecting Confidential Data and Preserving Nuisances. (3 weeks)

Backing up important data, "Informatique et Libertés" law, Internet dangers, Computer hacking, Machine protection, Protection against viruses, Protection against cyber threats or online threats (Phishing, spam emails, spyware, malware, ransomware, viruses and trojan horses, man-in-the-middle attacks, etc.), Preventing data loss, Spam or junk mail, Hoaxes, Cryptology, Electronic signature....

**Evaluation mode :**

Continuous assesment: 00%; Exam:100%.

**References**

1. Jean-Denis Commeignes, 12 méthodes de communications écrites et orale – 4<sup>ème</sup> édition, Michelle Fayet et Dunod 2013.
2. Denis Baril, Sirey, Techniques de l'expression écrite et orale, 2008.
3. 3-Matthieu Dubost, Améliorer son expression écrite et orale et toutes les clés, Edition Ellipses 2014.
4. Allegrezza Serge et Dubrocard Anne (edited by). Internet Econometrics. Palgrave Macmillan Ltd, 2011. ISBN-10: 0230362923 ; ISBN-13: 9780230362925
5. Anduiza Eva, Jensen J. Michael et Jorba Laja (edited by). Digital Media and Political Engagement Worldwide. Cambridge University Press - M.U.A, 2012. ISBN-10: 1107668492 ; ISBN-13: 9781107668492
6. Baron G.L., et Bruillard E. L'informatique et ses usagers dans l'éducation. Paris, PUF, 1996. ISBN-10: 2130474926; ISBN-13: 978-2130474920
7. En ligne Chantepie P. et Le Diberder A. Révolution numérique et industries culturelles. Repères. Paris, La Découverte, 2010. ISBN-10: 2707165050; ISBN-13: 978-2707165053
8. Dawn Medlin B. Integrations of Technology Utilization and Social Dynamics in Organizations. Information Science Reference (Isr), 2012. ISBN-10: 1-4666-1948-1; ISBN-13: 978-1-4666-1948-7
9. Devauchelle B. Comment le numérique transforme les lieux de savoirs. FYP Editions, 2012. ISBN-10: 2916571612; ISBN-13: 978-2916571614
10. Greenfield David. «The Addictive Properties of Internet Usage ». In Internet Addiction, 133-153. John Wiley & Sons, Inc., 2007. ISBN: 9780470551165. <http://dx.doi.org/10.1002/9781118013991.ch8>.
11. Kurihara Yutaka et [Al.]. Information technology and economic development. Information Science Reference (Isr), 2007. ISBN 10: 1599045818 ; ISBN 13: 9781599045818
12. Paquelin D. L'appropriation des dispositifs numériques de formation. Du prescrit aux usages. Paris, L'Harmattan, 2009. ISBN-10: 2296085563 ; ISBN-13: 978-2296085565
13. Tansey Stephen D. Business, information technology and society. Routledge Ltd, 2002. ISBN-10: 0415192137 ; ISBN-13: 978-0415192132

***Semester 6***

**Semester 6****Subject title: " Pharmaceutical chemistry II:therapeutic classes "****Code: F1.6.1****VHS: 45h00 (lesson :1h30, T:1h30)****Credits:4****Coefficient:2**

**Teaching objectives:** The goal is to provide the student with the appropriate knowledge to understand the physico-characteristics, their methods of obtaining as well as the main therapeutic uses.

**Recommended prior knowledge:** General chemistry and organic chemistry

**Content of the subject**

- Introduction about the drug
- Origins of medicinal substances
- Medicines of plant origin: aromatherapy, phytotherapy...
- Drugs of animal origin: drugs {organ-based, blood-derived drugs
- Drugs derived from biotechnology: vaccines, antibiotic therapy, etc.
- Drugs resulting from chemical synthesis or inorganic drugs: Some examples of therapeutic classes of major interest:
  - CNS drugs (central nervous system) Carbonic acid, urea and derivatives, barbiturates, hydantoin and antiepileptics, phenothiazines and neuroleptics
  - Amino-alcohols: Simple amino-alcohols, atropine and derivatives, local anesthetics catechol amines, ephedrine and amphetamines
  - Antibiotics: beta-lactams, chloramphenicol, aminoglycosides, tetracyclines, macrolides
  - Sulfonamides: Bacteriostatic sulphonamides, hypoglycaemic sulphonamides, diuretic sulphonamides
  - Anti-inflammatories
  - Vitamins
  - Medicines of the cardiovascular system

**Evaluation mode :**

Continuous assesment: 40%; Exam: 60%.

**References** (Books and handouts, websites, etc

**Semester 6**  
**Subject title: "Galenic Pharmacy"**  
**Code:F1.6.1**  
**HVS:45h00 (lesson:1h30, T:1h30)**  
**Credits:4**  
**Coefficient:2**

**Teaching objectives:** The objective of the course is to train students in galenic formulation, on the role of excipients and in the masterful preparation of conventional pharmaceutical forms based on the physicochemical and pharmacokinetic knowledge acquired.

The topics covered include: solid pharmaceutical forms (solid forms for oral use, forms for rectal use). Liquid pharmaceutical forms (solutions for oral use, injectable and ophthalmic forms); disperse systems (emulsions including dermatological preparations, suspensions and aerosols); for each form, the principles of the formulation, the excipients, the methods of preparation and the controls are discussed.

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

**Content of the subject:**

- **Chapter I:** Forms of solid drugs:
  - Powder manufacturing process steps, Physico-technological properties of powders, Mixing of powders
- **Chapter II:** Tablets
  - Study of the physicochemical parameters of the tablets, Granulation, drying and treatment of the granules, Compression machines, covering of the tablets by a membrane and film, Testing and conservation of the tablets.
- **Chapter III:** Forms of liquid medicines Suspensions and emulsions
  - Preparation of injection solutions III.3. Colloidal solutions: Eye solutions
- **Chapter IV:** Ointments
  - Mode of preparation of ointments based on hydrophilic and hydrophobic substances
- **Chapter V:** Ampoules
  - Ampoules (muscle plasters) and poultrices, medicinal pencils, capsules (ovules).
  - Drugs prepared under aseptic conditions.
  - Ampoules and their preparations
- **Chapter VI:** Packaging of drugs Packing and packaging of drugs and galenic preparations.

**Evaluation mode :**

Continuous assesment : 40%; Exam: 60%.

**References** (Books and handouts, websites, etc

**Semester 6**  
**Subject title: "Microbiology"**  
**Code: F1.6.1**  
**HVS: 45h00 (lesson: 1h30, T: 1h30)**  
**Credits: 4**  
**Coefficient: 2**

**Teaching objectives:** To know certain notions of general and industrial microbiology which provide them with certain essential knowledge: Knowing that the preparation of any medicine must be carried out under aseptic and sterile conditions, that is to say in the total absence of microbes (bacteria, viruses, fungi, etc.). Therefore, the acquisition of these notions as well as others is very important.

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

**Content of the subject:**

- Introduction to the microbiology laboratory;
- Sterilization processes;
- Culture media and inoculation methods;
- Macroscopic study of microorganisms in solid culture;
- Microscopic study of bacteria: Observation in the fresh state, simple and Gram staining;
- Biochemical identification of bacteria;
- Study of bacterial growth;
- Growth inhibitors, antibiogram; Yeasts and cyanobacteria;

**Evaluation mode :**

Continuous assesment : 40%; Exam: 60%.

**References** (Books and handouts, websites, etc

**Semestre 6**  
**Subject title: " Separation Techniques and Environment "**  
**Code:F1.6.2**  
**HVS:45h00 (Cours:1h30, TD:1h30)**  
**Credits:4**  
**Coefficient:2**

**Teaching objectives:**

Master the separative techniques of process engineering (complementary to Unit Operations) taking into account the environmental aspect (treatment of effluents).

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

**Content of the subject:**

- Unit operations
- Absorption, desorption.
- Adsorption (cycle, regeneration).
- Separation by membranes.
- Coagulation, flocculation.
- Drying.
- Environmental applications
- Treatment of gaseous and liquid effluents and waste.
- Industrial columns
- Design and sizing of columns, hydrodynamics of columns.
- Industrial column technology
- Packed column, various types of packing, nature, properties, choice.
- Column with trays, caps, valves, perforated grids.
- Comparison of columns with trays and columns with packing, selection criteria
- , implantation.
- Choice of material.

**Evaluation mode :**

Continuous assesment : 40%; Exam: 60%.

**References** (Books and handouts, websites, etc

**Semester 6**  
**Subject title: "PW Pharmaceutical II"**  
**Code: M1.6**  
**VHS: 22h30 (TP: 1h30)**  
**Crédits: 2**  
**Coefficient: 1**

**- Teaching objectives**

Apply knowledge of organic and mineral chemistry to certain categories of molecules important for their biological effects and make the link between theories and practice relating to the action of drugs

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

**Content of the subject:**

- General methods for studying the authenticity of medicinal preparations
- Analysis of medicinal preparations
- Synthesis and analysis of drugs with a heterocyclic structure
- Synthesis and characterization of a medicinal active ingredient of the class of aniline derivatives
- Dosage of paracetamol of gallamine phenyl butazone d'hydrate
- Dosage of benzalkonium sulfanilamide chloride by bromination
- Dosage of acid barbital and monosodium barbital in a mixture (dosage of acidity, dosage of sodium)
- Dosage of propylene glycol from alcohol in the anesthetic chloroform

**Evaluation mode :**

Continuous assessment: 100%; Exam: 00%.

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

**Semester 6****Subject title: "PW Galenic Pharmacy"****Code: M1.6****HVS: 22h30(PW:1h30)****Credits: 2****Coefficient: 1****Teaching objectives:**

The objective of the practical work is to train students in galenic formulation: role of excipients, masterful preparation of conventional pharmaceutical forms based on the physicochemical and pharmacokinetic knowledge

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

*Content of the subject:*

- PW1: Preparation of solutions by the volume method
- PW 2: Preparation of active ingredient solutions
- PW 3: Preparation of ointments
- PW 4: Preparation of powders
- PW 5: Preparation of syrups and potions
- PW 6: Dosage of liquid drugs by volume and by drops

**Evaluation mode :**

Continuous assesment: 100%; Exam: 00%.

**References** (Books and handouts, websites, etc

**Semester 6**  
**Subject title: "PW Microbiology"**  
**Code: M1.6**  
**HVS: 15h00(PW:1h00)**  
**Credits: 1**  
**Coefficient: 1**

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

*Content of the subject:*

- Introduction to the microbiology laboratory;
- Sterilization processes;
- Culture media and inoculation methods;
- Macroscopic study of microorganisms in solid culture;
- Microscopic study of bacteria: Observation in the fresh state, simple and Gram staining;
- Biochemical identification of bacteria;
- Study of bacterial growth;
- Growth inhibitors, antibiogram;
- Yeasts and cyanobacteria;

**Evaluation mode :**

Continuous assesment: 100%; Exam: 00%.

**References** (Books and handouts, websites, etc

**Semester 6****Subject title : " Techniques d'analyse "****Code : M 1.6****VHS :45h00 (lesson:1h30, PW:1h30)****Crédits : 3****Coefficient :2**

**Teaching objectives:** Acquire the theoretical principles, know the applications and limitations of modern instrumental analytical techniques; become familiar with the construction of the apparatus used in these techniques; be able to choose the most appropriate technique for various analytical problems. The course aims to enable them to understand the theoretical bases and the practical constraints underlying instrumental analysis in pharmaceutical process engineering and in drug analysis and control laboratories.

**Recommended prior knowledge** (succinct description of the knowledge required to be able to follow this course – Maximum 2 lines

*Content of the subject**Chapter I.**General information on physical methods of analysis**Physical properties of matter, choice of an analysis technique, instruments, Example, Atomic Absorption Spectrometry**Chapter II.**Spectroscopic methods.**II.1 - general remarks on the Spectroscopic methods.**III.2-the electromagnetic spectrum**III.3-electromagnetic radiation.**Chapter III. Absorption spectra in the ultraviolet and the visible**III.1-general information and field of application.**III.2 - components of a spectrometer**III.3- light absorption laws.**III.4-application of this method.**Chapter VI. Infrared spectroscopy**VI.1 — field of application of the method.**VI.2-molecular vibrations.**VI.3 - instrumentation.**VI.4- sampling.**VI.5-interpretation of an infrared spectrum.**Chapter V. Separative methods: Chromatography History and definition, different chromatographies, Thin layer chromatography, column and liquid chromatography (HPLC)**II.5 - Gas phase chromatography,**II.5.1- principle and definition, apparatus: the accessories of a chromatography apparatus, retention quantities and their properties, efficiency of a column, qualitative and quantitative analysis.***Evaluation mode:**

Continuous assesment: 40%; Exam: 60%.

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

**Semester: 6**  
**Subject title: Entrepreneurship and business management**  
**Code : TUT 3.2**  
**HVS : 22h30 (lesson : 1h30)**  
**Credits : 1**  
**Coefficient : 1**

### Teaching objectives:

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

- **Recommended prior knowledge:** No particular knowledge, except mastery of the language of instruction.

- **Targeted skills :**

Ability to analyze, synthesize, work in a team, communicate well orally and in writing, be independent, plan and meet deadlines, be reactive and proactive. Become aware of entrepreneurship through the presentation of an overview of management knowledge useful for the creation of activities.

#### *Content of the subject*

**Chapter 1** – Operational preparation for employment: (2 weeks) Writing of the cover

letter and development of the CV, Job interview, ...,

Documentary research on the professions in the sector, Conduct of interviews with professionals in the profession and Simulation of job interviews.

**Chapter 2** - Entrepreneurship and Entrepreneurial Spirit: (2 Weeks)

Entrepreneurship, Companies around you, Entrepreneurial motivation, Knowing how to set objectives, Knowing how to take risks

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

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

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

Creativity and innovation, Recognizing and evaluating business opportunities

**Chapter 5**–Lancer and Running a Business: (3 Weeks)

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

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

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

**Evaluation mode:**

Continuous assesment : 00%; Exam: 100%.

**References :**

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

***Semester 1 Master***

**Semester : 1**  
**Teaching unit : FTU 2.1.1**  
**Subject 1 : General pharmacology**  
**SHV : 22h30 (Lecture : 01h30)**  
**Crédits : 10**  
**Coefficient : 5**

### **Teaching objectives**

At the end of this teaching entity, the student will have acquired knowledge of the fundamental concepts in pharmacodynamics and pharmacotherapy. He will be able to define the main drug targets and understand the methods used to determine their activity. He will have acquired the fundamental notions governing the relationship between drugs and their targets. He will understand all the general notions relating to the use of drugs.

### **Recommended prior knowledge**

Basic notions of biochemistry and biology

**Chap 1:** Mechanisms of action of drugs (3 weeks)

**Chap2 :** Quantitative study of the relationship between receptor binding and response pharmacological (3 weeks)

Basic notions on the identification, classification and regulation of receptors.

**Chap3 :** General pharmacotherapy (3 weeks)

Therapeutic index ; Tolerance and drug dependence; Adverse effects;

**Chap4 :** Drug interactions (3 weeks)

Clinical evaluation of drugs: placebo effect, clinical trials.

**Chap5 :** Systematic description of pharmacological targets at the molecular level and their implications in various pathophysiological processes. (3 weeks)

### **Assessment method:**

Continuous assesment : 40% ; Exam: 60%.

### **Bibliographic references**

1. Rang and Dale's Pharmacology, Rang H.P., Elsevier, 8th edition (2015).
2. Basic and Clinical Pharmacology, B.G. Katzung, MacGraw-Hill Professional Publishing, 13th edition (2014).
3. Goodman and Gilman's The Pharmacological Basis of Therapeutics, L. Brunton et al. 12th edition (2011).

**Semester : 1**

**Teaching unit : FTU 2.1.2**

**Subject 1 : General pharmacology**

**SHV : 22h30 (Lecture : 03h00, T : 01h30)**

**Crédits : 6**

**Coefficient : 3**

### **Teaching objectives**

Allow the student to choose the most appropriate analytical method for a given problem in the context of drug analysis (raw material, related substances, mixed substances, etc.).

### **Recommended prior knowledge**

Organic Chemistry, Pharmaceutical Organic Chemistry, Instrumental Analysis (Physicochemical methods of analysis)

### **Material content**

- Identification of structures by optical and photobiological spectroscopy (Raman, IRTF, fluorescence, phosphorescence, etc.)
- Identification of structures by nuclear magnetic resonance (one-dimensional and two-dimensional, example: COZY, NOSY, DEPT, INDEPT..)
- Electrophoresis
- Mass spectroscopy and coupling of mass spectroscopy with separation methods

### **Assessment method**

Continuous assesment : 40% ; Exam : 60%.

### **Bibliographic references**

Mass spectrometry: course and ex corrected.	DEHOFFMANN,
E.	
Mass spectrometry: principles and applications	Constantin, E
Infrared and raman spectroscopy	Poilblanc, René
Infrared and raman spectroscopy	Poilblanc, René
Absorption and fluorescence: principles and applications Albani,	Jihad René
Instrumental methods of chemical analysis and applications:	
methods chromatography, electrophoresis and spectral methods.	Burgot,
Gwenola	
Principles of instrumental analysis.	SKOOG.
Instrumental methods of chemical analysis and applications.	BURGOT, G.
Spectrometer identification.	SILVESTIN.
molecular fluorescence.	VALUE.

**Semester 1****Teaching unit : FTU 2.1.2****Subject title: "Heterogeneous Reactors****SHV : 45h00 ( Lecture : 1h30, T: 1h30)****Credits : 4****Coefficient : 2****Teaching objectives**

The course deals with the main chemical engineering models involved in the representation of reactors and the analysis of their operation. Extensive integration is achieved with application issues and case studies.

**Recommended prior knowledge**

Chemistry and thermodynamics

**Material content**

- Homogeneous reactors

General balance equations and sizing of ideal adiabatic reactors – Analysis the behavior of non-ideal reactors. Study of the distribution of residence times. Models of the axial dispersion reactor, series mixing reactors.- Heterogeneous catalytic reactors. Micro-kinetics at the catalyst grain level (Wheeler's theory). Sizing of fixed-bed and fluid-bed reactors (Davidson and Harrison model).

- Liquid gas reactors.

Hatta theory. Dimensioning of mixing reactors and absorption columns.

**Assessment method**

Continuous assessment: 40%; Exam: 60%.

**Bibliographic references**

JacquesVilliermaux "Chemical reaction engineering, design and operation of reactors". Tec and Doc, 1995.

PierreTrambouze, Jean-Paul Euzen "Chemical Reactors". Editions Technip, 2002.

Michel feidt, ENERGETICS–Concepts and applications. 2006, Edt.DUNOD, ISBN2100490664.J.R.WELTY;R.EWILSON;C.EWICKS, "Fundamentals of momentum, heat and mass transfer", John Wiley and Son, New–York (1976)

C.O.BENNET;J.E.Myers "Momentum, Heat and Mass Transfer" John Wiley and Son,New–York(1974)

F.P.INCROPERA;D.P.Dewitt,«Fundamentals of Heat and MassTransfer»,John Wiley and Son,New–York(1985)

**Semester 1****Teaching unit : FTU 2.1.2****Subject title : Pharmacognosy****SHV : 45h00 (Lecture : 01h30)****Credits : 2****Coefficient : 1****Teaching objectives**

At the end of this course, students must know the main raw materials of natural origin know the main types of active principles of natural origin, their physicochemical and pharmacological properties - understand the principles of the analysis techniques used to determine the quality of drugs of natural origin. The program of this master will encompass the pharmacological properties of drugs of natural origin, possible interactions, as well as side effects. Notions of biosynthesis for each chemical class will also be discussed.

At the end of the course, examples will be presented illustrating the importance of chemotaxonomy and ethnopharmacology.

**Prior knowledge recommended**

Basic notions of general chemistry

**Material content****Part A: General pharmacognosy**

- Main classes of active ingredients of natural origin, and Criteria for quality of plants and plant extracts, methods of identification or screening of the main classes of active ingredients listed below.
- Biogenesis, physico-chemical and pharmacological properties of main natural active ingredients

**Part B: Special pharmacognosy**

- General information about herbal medicine: its advantages and limitations as well as the risks and dangers associated with the uncontrolled use of plants
- Main forms of use of plants in pharmacy

Most common plants used in pharmacy (parts used, chemical composition, quality criteria, pharmacological properties, main uses, side effects, contraindications, doses).

**Assessment method**

Continuous assesment : 00% ; Exam : 100%.

**Bibliographic references**

Lu-qi Huang (auth.), Lu-qi Huang (eds.) Molecular Pharmacognosy, Springer Netherlands(2013).

***Semester 2 Master***

**Semester 2****Teaching unit : FTU 2.2.1****Subject title : Biochemical and microbiological engineering****SHV : 67h30 (Lecture: 03h00, T : 1h30)****Credits : 6****Coefficient : 3****Teaching objectives**

- Describe and explain the theoretical principles and key factors on which the operation of bioreactors is based - Establish and calculate material and energy balances of biotechnological systems and interpret the results. - Develop reasoning and calculations, based on (bio)chemical and biological kinetics, for the dimensioning of discontinuous, infinitely mixed continuous and semi-continuous reactors and to apply them in specific cases.-Describe, explain and calculate the phenomena of mass, energy and quantity transfer of movement that can take place within bioreactors, in particular in connection with aeration and agitation.- Find the real values of constants or other correlation parameters essential to the sizing of biological reactors.- As part of the design of a new biological reactor, propose in a reasoned manner (with its advantages and limitations) the design of the most appropriate reactor in relation to the industrial context considered.

**Recommended prior knowledge**

Phenomenon of transport, unit operations, biochemistry and microbiology.

**Material content**

- From the design to the transposition to the pilot scale of microbiological and enzymatic processes. Theoretical and methodological bases of applied chemical kinetics and the design of chemical reactors with the particularities (kinetics and transport phenomena) of biochemical and microbiological processes with the aim of systematizing the principles underlying the analysis and sizing of bioreactors .

- (Micro)biological processes characterized kinetically and thermodynamically: Cell growth, its measurement or estimation, use of substrate(s), production of product(s). Yields. Productivities. Kinetic models. Parameter estimation.

- Methodology of material and energy balances for the analysis of biotechnological systems and their performance.

- Discontinuous, continuous, semi-continuous reactors.

- Transfer phenomena applied to the analysis of aeration, agitation, rheology, scale transposition and sterilization of bioreactors.

**Assessment method**

Continuous assesment : 40% ; Exam: 60%.

**Bibliographic references**

- Bioprocess Engineering Principles' by Pauline M. Doran 2nd edition (2013)  
 - Bioprocess Engineering' by Michael L. Shuler & Fikret Kargi 2nd Edition (2002)

**Semester 2****Teaching unit : FTU 2.2.1****Subject title : Industrial Production of Solid Form Medicines****SHV : 45h00 (Lecture : 01h30, T : 01h30)****Credits : 4****Coefficient : 2****Teaching objectives:**

The student will assimilate the fundamental notions of the formulation and production of solid pharmaceutical forms. Thus, we will approach the various industrial stages which lead to the manufacture dry forms of the drugs. The student should be able to understand the mechanisms involved in the production of dry forms and the operation of equipment.

**Recommended prior knowledge:**

Pharmaceutical processes

**Material content:****Chapter 1: Art of dry shapes (1 week)**

Reminder of dry dosage forms; Manufacturing processes for sachets, capsules and tablets

**Chapter 2: Grinding (1 week)**

General, particle size; grinding modes; Crushing devices; Control powder particle size

**Chapter 3: Mixing pharmaceutical powders (2 weeks)**

The mixing of powders; Interest in the pharmaceutical industry; Principle of mixing and unmixing powders; Powder mixing factors; Randomized (random) shuffling and Structured (ordered) shuffling; Equipment (cubic mixer, V, etc.); Controls (dosage, calculation of the mean, variance, coefficient of variation, etc.)

**Chapter 3: The granulation process of pharmaceutical powders (3 weeks)**

Wetting phenomenon; Forces involved; Pellet growth and consolidation (pendulum, funicular, capillary, drop); Constraint and breakage of granules; Equipment (High Shear, fluidized bed, etc.); Controls (dosage, flow, volume meter, etc.)

**Chapter 4: Fluidized air bed drying of pharmaceutical granules (4 weeks)**

Fluidization theory (hydrodynamics, minimum fluidization velocity, terminal velocity of fall, Darcy's law, Ergun's law, Geldart diagram, etc.); Principle of fluidized bed drying; Heat transfer modes; Drying steps (speed of drying, constant speed, decreasing speed...); Air parameters (adsorption isotherm, Mollier diagram, etc.); Control (dosage, humidity, etc.)

**Chapter 5: The compression of pharmaceutical powders (3 weeks)**

Description of the presses (rotary, alternative); Compression cycle; Densification models (Heckel, etc...); Control of tablets (hardness, friability, disintegration, dissolution, etc.); Establishment of control cards

**Chapter 6: Coating of medicinal tablets (1 week)**

Interest of lamination and coating; Principle of operation; Spraying of the coating solution (calculation of the size of the drops, surface of projection, etc...); Control of the tablets (hardness, friability, disintegration, dissolution, etc...)

**Assessment mode:** Continuous assesment: 40%; Exam: 60%.

**Bibliographic references**

Galenic pharmacy. Formulation and pharmaceutical technology. P.Wehle

**Semester 2****Teaching unit : FTU 2.2.2****Subject title : Heat Transfers and Heat Exchangers****SHV : 45h00 (Lecture : 01h30, T : 01h30)****Credits : 4****Coefficient : 2****Teaching objectives**

Complete the students' knowledge and teach them new concepts such as heat transfer in transient state, conduction through the fins and in the presence of a heat source as well as heat exchangers, and calculation methods for heat transfer.

**Recommended prior knowledge**

Heat transfer, fluid mechanics, notions of mathematics (first and second order differential equations, calculation of integrals, etc.).

**Material content**

**Chap. 1.** Reminders of Heat Transfer Laws (1 Week)

**Chap. 2.** Heat Conduction (1 Week)

**Chap. 3.** Thermal Convection (2 Weeks)

**Chap.4.** Description of Heat Exchange Devices without Phase Change (2 Weeks)

Double tube exchangers, Core and shell heat exchangers (shell, core and core-shell assembly) and Plate heat exchangers.

**Chap. 5.** Calculation of Exchangers (3 Weeks)

Study of heat transfer (fundamental equations, average temperature difference, global transfer coefficient U), Study of pressure losses (Loss of pressure inside the tubes, Loss of pressure outside the tubes), Methods of calculation (Calculation of a double-tube heat exchanger, Calculation of a bundle and shell heat exchanger (Kern method)), General considerations on the calculation of a bundle and shell device and programming of the calculation.

**Chap 6.** Heat Exchange Devices with Phase Change (3 Weeks)

Description of the devices, condensation of a pure vapor (Film coefficients for condensation outside the tubes, Calculation of the condenser, Condensation preceded by a desuperheating of the vapor and followed by the cooling of the condensate), Condensation of a vapor complex (Calculation of the own transfer coefficient (Ward method and Kern method), Pressure drop in the shell, Example of calculation), forced circulation flooded reboilers (Reboiling of a pure substance in the shell, Reboiling of a mixture in the shell), Level Reboilers with Natural Circulation, Flooded Reboilers with Natural Circulation, example of Calculation of a Reboiler.

**Chap 7.** Finned Tubes (2 Weeks)

1/ Integral low fins: Description, Efficiency, Overall heat exchanger transfer coefficient, Condensation film coefficient on horizontal finned tubes and Loss of charge.

2/ High fins: Description and study of air coolers.

**Assessment method**

Continuous assesment : 40% ; Exam: 60%.

**Bibliographic references**

1. J.F. Sacadura, Thermal transfers – Initiation and deepening, Ed. Lavoisier, 2015.

2. R.B Bird, W.E. Stewart, E.N. Lightfoot, Transport phenomena, 2nd Ed., Wiley & Sons, 2007.

A. Giovannini and B. Bédard, Heat transfer, Ed. Cépaduès, 2012.

3. James R. Welty, Charles E. Wicks, Robert E. Wilson; Gregory Rorrer, Fundamentals of

Momentum,

Heat, and Mass Transfer. 4th edition Wiley & Sons, 2001.

4. Leontiev, Theory of Heat and Mass Exchanges – Mir-Moscow Edition

5. H.W. Mac Addams The transmission of heat - Dunod - Paris

6. F.P. Incropera, D.P. Dewitt - Fundamentals of Heat and Mass Transfer - Wiley, N.Y. - 2002

7. Bontemps, A. Garrigue, C. Goubier, J. Huetz, C. Marvillet, P. Mercier And R. Vidil – Echangeur de

heat – Engineering Technique, Energy Engineering Treatise

8. P. Wuithier, Petroleum, Refining and Chemical Engineering volume 2, Edition technip Paris

**Semester 2****Teaching unit : FTU 2.2.2****Subject title : process management****SHV : 45h00 (Lecture : 01h30, T : 01h30)****Credits : 4****Coefficient : 2****Teaching objective**

- set up the mathematical model adapted to the design of the control;
- analyze the control problem;
- choose and synthesize an appropriate control strategy;
- evaluate the performance of the chosen control strategy

**Recommended prior knowledge**

Math.

**Material content**

Evaluation of performances.

Order analysis

**Assessment method** : Exam : 100%

**Semester 2****Teaching unit : FTU 2.2.2****Subject title : Galenic pharmacy****SHV : 22h30 (Lecture : 01h30)****Credits : 2****Coefficient : 1****Teaching objectives**

The objective of this subject is to know the various pharmaceutical forms.

**Material content****Chap 1 : General point (1 week)**

- Definition, purpose, galenic formula, composition, excipient with known effect

**Chap 2 : Powders, Granules and tablets (2 weeks)**

- Powdered substances for pharmaceutical use -Evaluation of functionality
- Pellets and granulation
- Tablets: study of the physicochemical parameters of the tablets, granulation, pellet drying and processing, compression machines, testing and conservation tablets, uncoated tablets, membrane coated tablets and film - Modified-release tablets: accelerated-release tablets, Delayed-release tablets, prolonged-release tablets

**Chap 3 : Capsules – Soft capsules and biopharmaceutical control of oral forms solids (1 week)**

- Capsules with hard shells or capsules ; -Soft capsules ; -Controls of capsules and soft capsules ; - Biopharmaceutical control of solid oral forms

**Chap 4 : Solutions, suspensions and emulsions for oral, parenteral routes and ophthalmic (2 weeks)**

- Solutions, Suspensions, Emulsion, Dry emulsions, Liquid preparations for oral use, Parenteral preparations, Ophthalmic forms

**Chap 5 : Preparations for inhalation (2 weeks)**

- Respiratory Tract – Anatomy and Physiology- Liquid preparations for inhalation- Powders for inhalation - Pharmacotechnical testing of inhalation preparations

**Chap 6 : Dosage forms applied to the skin – suppositories (2 weeks)**

- Galenic forms applied to the skin, Suppositories

**Chap 7: Spheroids and vectorized shapes (1 week)**

- Microparticles, Nanoparticles, Liposomes,

**Chap 8: Dosage forms in development (2 weeks)**

- Bioencapsulation, Implants, Mesoporous materials of pharmaceutical interest, Bioadhesive forms, Iontophoresis, Colloidal systems of cyclodextrins

**Chap 9: Packaging of drugs (2 weeks)****Assessment method**

Continuous assesment : 40%; Exam : 60%.

**Bibliographic references**

- 1- Marie-Ange Dalmasso, Olivier Allo, Pascale Blanc, Galenic Pharmacy BP, Les Editions Porphyry (2013).
- 2- Pascal Wehrli, Galenic pharmacy: formulation and pharmaceutical technology, Edition Maloine (2012)

**Semester 2****Teaching unit : MTU 2.2****Subject title : Sterilization/Lyophilization****SHV : 22h30 (PW : 01h30)****Credits : 1****Coefficient : 1****Teaching objectives**

This subject aims to familiarize students with the aspects theory and basic principles of sterilization and freeze-drying

**Recommended prior knowledge**

Basic notions in chemistry and physical chemistry

**Material content****1. Sterilization**

The chemical route, Radiation, Sterilizing micro-nanofiltrations, heat treatments, Other methods: pulsed light energy, pascalization, microwaves, ultrasounds etc.

**2. Lyophilization**

- Physical phenomena underlying freeze-drying
  - Transfer of heat and matter in lyophilization
  - Principle of freeze-drying
  - Main parameters of the freeze-drying cycle
  - Reading of freeze-drying graphs and interpretations
- Equipment and procedure
  - Equipment
  - Freeze-drying cycle and important parameters that govern the cycle
- Methods
  - Freezing
  - Primary drying
  - Secondary drying
- Wording
  - Buffering agents, Stabilizing agents, Bulking agents, Modifying agents
  - collapse temperature, Isotonizing agents, Surfactants, Agents
  - antioxidants , Antimicrobial agents
- Quality criteria required for a lyophilisate for therapeutic use
  - Physical state and physical appearance of the lyophilisate
  - Degree of residual humidity
  - Replenishment time
  - pH
  - Integrity of the active ingredient

**Assessment method**

Continuous assesment : 100%

***Semester 3 Master***

**Semester 3****Teaching unit : FTU 2.3.1****Subject title : Industrial production of drugs in liquid and paste forms****SHV : 45h00 (Lecture : 01h30, T : 1h30)****Credits : 4****Coefficient :****Teaching objectives**

The student will assimilate the fundamental notions of the formulation and production of liquid and semi-solid pharmaceutical forms. In addition, we will discuss the different industrial steps that lead to the manufacture of these pharmaceutical forms as well as the operation of the equipment.

**Recommended prior knowledge**

Pharmaceutical processes

**Material content****Chap 1: Art of liquid forms**

## 1. Solutions

- Drinkable solutions, syrups, elixirs, drinkable ampoules...
- Solubility and solubilization techniques, factors influencing dissolution
- Preparation processes
- Solubilizing agents : Inclusion complexes, surfactants...

## 2. Emulsions

- Structures and types of emulsions, formulation and stability, choice of surfactant, HLB required, conductivity, viscosity, dispersity, phase diagrams
- Emulsification processes
- Microemulsions

## 3. Suspensions

- Pharmaceutical applications, instability factors, stabilizers, additives
- Wording

**Chap 2 : Art of Semi-Solid Forms**

1. Ointments ; 2. Creams ; 3. Gels: gelling mechanisms, hydrogels, oleogels and emulgels
4. Pasta

**Chap 3: Mixing**

1. Principle ; 2. Liquid substance mixers: Paddle, turbine, propeller stirrers, etc. ; 3. Mixers of pasty substances: Mixer-kneaders ; 4. Homogeneity check

**Chap 4: Dissolution**

1. Principle ; 2. Simple dissolution ; 3. Dissolution by intermediary ; 4. Extractive dissolution

**Chap 5: Preparation of injectable forms**

1. Preparation ; 2. Filling ; 3. Control: Clarity, Neutrality, Isotony...

**Chap 6: Preparation of semi-solid shapes**

1. Preparation ; 2. Apparatus ; 3. Packaging ; 4. Pharmaco-technical trials

Apps : 1. Preparation of a syrup ; 2. Preparation of zinc oxide ointment ; 3. Preparation of a cleansing milk

**Assessment method**

Continuous assesment: 40%; Exam: 60%

**Semester 3****Teaching unit : FTU 2.3.1****Subject title : Biopharmacy and Pharmacokinetics****SHV : 22h30 (Lecture : 01h30)****Credits : 2****Coefficient :****Teaching objectives**

Acquire knowledge about the use of drugs and the interactions of the drug with the body

**Recommended prior knowledge**

The basics of pharmaceutical chemistry

**Material content****Chap 1 :**

The different phases of drug distribution in the body (ADME):

**Chap 2**

Biopharmaceutical aspects of drugs (modalities of absorption, dissolution test, in vitro-in vivo correlation, bioavailability and bioequivalence, System of biopharmaceutical classification of drugs)

**Chap 3**

Single drug administration (pharmacokinetic model study)

**Chap 4**

Repeated drug administration (pharmacokinetic model study)

**Chap 5**

Complex models and nonlinear models,

**Assessment method**

Exam : 100%

**Semester 3****Teaching unit : FTU 2.3.1****Subject title : Bioreactors****SHV : 45h00 (Lecture : 01h30 ; T : 01h30)****Credits : 4****Coefficient :****Teaching objectives**

Introduction of the basic concepts necessary for the implementation of the design and analysis of industrial scale bioreactors

**Recommended prior knowledge**

Basic notions in chemistry and biochemistry and chemical reaction engineering

**Material content****I- Introduction (2 weeks)**

Reminders of basic knowledge of microbiology, biochemistry and biology molecule necessary for the calculation of bioreactors

**II- Modeling reaction rates in biological systems (3 weeks)**

- Microbial kinetics: Monod model
- Enzyme kinetics
- Inhibition of enzymatic reactions

**III- Design and analysis of bioreactors (5 weeks)**

- Types of bioreactors
- Basic concepts
- Batch bioreactors
- Continuous stirred tanks
- Plug-in bioreactors
- Comparison of batch bioreactors and continuous bioreactors

**IV- Sterilization (2 weeks)**

- Physical sterilization
- Chemical sterilization

**V- Material transfer in bioreactors (3 weeks)**

- Aeration: gas-liquid material transfer
- Agitation: material transfer by forced convection

**Assessment method**

Continuous assesment: 40%; Exam: 60%

**Semester 3****Teaching unit : FTU 2.3.2****Subject title : Water production for the pharmaceutical industry****SHV : 45h00 (Lecture : 01h30 ; T : 01h30)****Credits : 4****Coefficient :****Teaching objectives**

Water is the most used utility in the pharmaceutical industry or more simply during the preparation of the vast majority of drugs. It is used as an excipient, to reconstitute a drug, during the stages of synthesis of the active ingredient or the formulation of the finished product or as the main element for cleaning tanks, equipment or primary packaging. The objective of this material is to present the different types of water for pharmaceutical use and the processes for producing these waters.

**Recommended prior knowledge**

Chemistry of solutions, basic unit operations,

**Material content**

1- Fundamental principles of water chemistry

- Total organic carbon (TOC)

2- Standards of physico-chemical and microbiological qualities of water for pharmaceutical use

3- Different qualities of water for pharmaceutical use

- Purified water: Purified water in bulk, Purified water packaged in containers
- Highly purified water
- Water for injections
- Water for hemodialysis
- Water for irrigation (pourable water)
- Sterile water
- Water used during the manufacture of the active ingredients
- Water used during cleaning and rinsing cycles

4- Sources of water supply

Natural waters and drinking water

5- Processing methods

- Prefiltration
- Adsorption on activated carbon
- Softening
- Demineralization
- Ultrafiltration, Osmosis and Electro-deionization (EDI)
- Distillation
- Filtration
- Disinfection: Ozonation, UV, others....

6- Storage and distribution of water for pharmaceutical use

**Assessment method**

Continuous assesment : 40% ; Exam : 60%

**Semester 3****Teaching unit : FTU 2.3.2****Subject title : Water production for the pharmaceutical industry****SHV : 45h00 (Lecture : 01h30 ; T : 01h30)****Credits : 4****Coefficient : 2****Teaching objectives**

The objective of this course is to enable students to master the knowledge essential to the optimization, modeling and simulation of continuous processes and to become familiar with

the use of simulation software.

**Recommended prior knowledge**

Equations governing Transfer Phenomena in Process Engineering in stationary mode, the bases of thermodynamics and kinetics.

**Material content****Chap I : Modeling and simulation**

I.1. Introduction to the modeling of physical phenomena

I.2. Methods for solving systems of algebraic equations.

- Solving the RK and RKS equations of state using Excel and another software for a pure gas and a mixture of gases

- Calculation of L-V equilibrium and isothermal flash separation using Excel or other software.

- Calculation of the equilibrium compositions of a reaction using Excel or other software.

I.3. Methods for solving systems of differential equations.

- Calculation of perfectly stirred continuous reactors using Excel or other software.

- Calculation of an isothermal tubular reactor with software.

**Chap II: Optimization**

II.1. Optimization problems in process engineering

II.2. Monodimensional and multidimensional direct search

II.3. Mathematical approach to unconstrained optimization

II.4. Problems with equality constraints and with inequality constraints

II.6. Solving Constrained Optimization Problems Using Excel®

II.7. Linear programming

- Graphic method ; - Simplex methods (with and without basic solution)

**Assessment method** : Continuous assesment: 40%; Exam: 60%.

**Bibliographic references**

1. Yadolah Dodge "Applied Optimization" Springer – Verlag France 2005, ISBN: 2-287-21335-X

2. Lorenz T. Biegler. "Nonlinear programming: concepts, algorithms, and applications to chemical processes", 2010 by the Society for Industrial and Applied Mathematics and the Mathematical, Optimization Society

3. Bruce a. Finlayson, "Introduction to chemical engineering computing", 2006 by John Wiley & Sounds, Inc.