

**PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA**

**MINISTRY OF HIGHER EDUCATION  
AND SCIENTIFIC RESEARCH**

# **HARMONIZATION MASTER TRAINING OFFER**

**ACADEMIC**

<b>Establishment</b>	<b>Faculty / Institute</b>	<b>Department</b>
<b>Mohamed Seddik Ben Yahia University - Jijel</b>	<b>Exact Sciences and Computer Science</b>	<b>Chemistry</b>

**Field: Material Science**

**Sector: Chemistry**

**Specialty: Pharmaceutical Chemistry**

**Academic year: 2021 / 2022**

# الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي

## عرض تكوين ماستر

### أكاديمي

المؤسسة	الكلية/ المعهد	القسم
جامعة محمد الصديق بن يحيى . جيجل	كلية العلوم الدقيقة و الإعلام الآلي	قسم الكيمياء

الميدان : علوم المادة

الشعبة : كيمياء

التخصص : كيمياء صيدلانية

السنة الجامعية: 2021 / 2022

# SUMMARY

<b>I - Identity card of Master</b> .....	<b>04</b>
1 - Location of training .....	05
2 - Training partners .....	05
3 - Context and objectives of the training .....	05
A - Access conditions .....	05
B - Training objectives .....	06
C - Profiles and skills targeted .....	06
D - Regional and national employability potential .....	06
E - Gateways to other specialties .....	06
F - Training monitoring indicators .....	06
G – Supervisory skills .....	06
4 - Human resources available .....	07
A - Teachers working in specialty .....	07
B - External Supervision .....	08
5 - Specific material resources available .....	09
A - Educational Laboratories and Equipment .....	09
B- Internships and training in companies .....	10
C - Research laboratories supporting the Master .....	10
D - Research projects to support the Master .....	10
E - Personal work spaces and ICT .....	10
<b>II - Half-yearly teaching organization sheet</b> .....	<b>11</b>
1- Semester 1 .....	12
2- Semester 2 .....	13
3- Semester 3 .....	14
4- Semester 4 .....	15
5- Overall summary of training .....	15
<b>III - Detailed program by subject</b> .....	<b>16</b>
<b>IV – Agreements / conventions</b> .....	<b>38</b>

## **I – Master's identity card**

## 1 - Location of the training:

- Mohamed Seddik Ben Yahia University - Jijel
- Faculty (or Institute): Exact Sciences and Computer Science
- Department: Chemistry

## 2- Training partners \*:

- other university establishments:
- businesses and other socio-economic partners:
- International partners:
- Present the conventions in the training appendix:

## 3 – Context and objectives of the training

### A – Conditions of access

- Bachelor's Degree in Pharmaceutical Chemistry
- Basic Chemistry Degree
- Organic Chemistry Degree
- Analytical Chemistry Degree

Students will be selected after studying their files and, if conditions require it, by competitive examination.

### B - Training objectives *(targeted skills, educational knowledge acquired at the end of the training)*

This Master's degree is designed for students wishing to specialize in pharmaceutical chemistry (design, development, and evaluation of new therapeutic molecules), and offers training that prepares them for fundamental and applied research. Obtaining this degree allows them to pursue research towards a doctoral thesis in the field of medicine.

### **C – Targeted job profiles and skills** (*in terms of professional integration*):

- Design, isolation and preparation of molecules for therapeutic purposes;
- Synthesis, identification and interpretation of chemical structures;
- Extraction and semi-synthesis of natural products;
- Molecular modeling and study of drug action modes;
- Analysis and quality control of medicines.

### **D- Regional and national employability potential of graduates**

- Pharmaceutical industry
- University education
- Scientific research

### **E – Gateways to other specialties**

- Master's degree in organic and bio-organic chemistry;

### **F – Training monitoring indicators**

- Knowledge assessment at the end of the semester;
- Continuous assessment and evaluation notes of the student's personal work;
- End-of-year catch-up test;
- Presentations and seminars;
- Defense: bibliographic research and practical internship (semester 4).

### **G – Supervision capacity** ( number of students to be supported): **15**

## **4 – Available human resources**

**A: Teachers from the establishment working in the specialty:**

**E\*: internship supervision and/or dissertation supervision**

**B: External Supervision:****Establishment of attachment:**

Name, first name	Graduation diploma + Specialty	Post-graduation diploma + Specialty	Grade	Type of intervention *	Signing in

**Establishment of attachment:**

Name, first name	Graduation diploma + Specialty	Post-graduation diploma + Specialty	Grade	Type of intervention *	Signing in

**Establishment of attachment:**

Name, first name	Graduation diploma + Specialty	Post-graduation diploma + Specialty	Grade	Type of intervention *	Signing in

\* = Courses, tutorials, practical work, internship supervision, dissertation supervision, other (to be specified)

## 5 – Specific material resources available

### A- Educational Laboratories and Equipment:

Lab title: Chemistry lab

No.	Equipment title	Number	observations
01	HPLC chromatography device	01	Nine
02	CPG chromatography device	01	Nine
03	Potentiostat with electrochemical impedance – Voltalab	01	Nine
04	Flame photometer	01	In working order
05	UV-VISIBLE spectrophotometer	02	In working order
06	VISIBLE spectrophotometer	03	In working order
07	Potentiometer	02	In working order
08	pH meter	10	In working order
09	Specific electrode	02	
10	Saturated calomel electrodes (SCE); Silver electrodes; Redox electrodes.		
11	Rotary Evaporator	03	In working order
12	Ice cream machine	01	In working order
13	Kofler Bench	01	
14	BUCHI melting point apparatus	01	In working order
15	Refractometer	02	In working order
16	Polarimeter	02	In working order
17	Oil bath	01	
18	Magnetic Heating Stirrers	20	
19	Soxhlet	02	
20	Dean Stark	02	
21	Refrigerants	20	
22	Distillation columns	10	
23	UV lamps	02	
24	Chromatography column	06	
25	Water heaters	08	
26	Reaction balloon	Several	
27	TLC plates	Several	
28	Glassworks	Varied	

## B- Internship and in-company training sites:

Internship location	Number of students	Duration of the internship
SONATRACH	20	1 Week
SAIDAL	20	1 Week
TANNERY	20	3 Days

## C- Research laboratory(ies) supporting the master's degree:

<b>Chef du laboratoire : Pr. Belghobsi Mabrouk</b>
<b>N° Agrément du laboratoire : N°42 du 05/02/2001</b>
Date : 18/05/2022
Avis du chef de laboratoire :
 مدير مختبر البحث بلغوبسي مبروك

## D- Research project(s) to support the master's degree:

Title of the research project	Project Code	Start date	End date
Synthesis of organic molecules - bioactive aurones, seleno- and thia-diazoles	E01720140093	01/01/2015	2018
Synthesis and pharmacological evaluations of bioactive molecules by structural optimization of heterocyclic compounds	B00L01UN18012013001	01/01/2013	2016

## E- Personal work spaces and ICT:

In addition to computer rooms for practical work, internet and reading rooms, a videoconferencing room is available for online training.

## **II – Half-yearly teaching organization sheet**

## 1- Semester 1:

Teaching Unit	VHS	VH weekly				Coefficient	Credits	Assessment method	
	14-16 weeks	C	TD	TP	Others			Continuous	Exam
<b>Fundamental EU</b>									
<b>UEF1(O/P)</b>									
Advanced Organic Chemistry	63h00	3:00 a.m.	1h30			3	5	33%	67%
Pharmacology I	63h00	3:00 a.m.	1h30			3	5	33%	67%
Quantum chemistry	63h00	3:00 a.m.	1h30			3	5	33%	67%
Physicochemical methods of analysis	42h00	1h30	1h30			3	4	33%	67%
<b>EU methodology</b>									
<b>UEM1(O/P)</b>									
Organic synthesis practical work	42h00			3:00 a.m.		2	4	50%	50%
Practical Pharmacology I	42h00			3:00 a.m.		2	4	50%	50%
<b>EU discovery</b>									
<b>UED1(O/P)</b>									
General Biology	9:00 p.m.	1h30				1	2		100%
<b>Cross-cutting EU</b>									
<b>UET1(O/P)</b>									
Scientific English	9:00 p.m.	1h30				1	1		100%
<b>Total Semester 1</b>	<b>357h00</b>	1:30 p.m.	6:00 a.m.	6:00 a.m.		<b>18</b>	<b>30</b>		

## 2- Semester 2:

Teaching Unit	VHS	VH weekly				Coefficient	Credits	Assessment method	
	14-16 weeks	C	TD	TP	Others			Continuous	Exam
<b>EU fundamentals</b>									
<b>UEF2(O/P)</b>									
Synthesis strategies and chemistry of heteroelements	63h00	3:00 a.m.	1h30			3	5	33%	67%
Pharmaceutical Chemistry	63h00	3:00 a.m.	1h30			3	5	33%	67%
Pharmacology II	63h00	3:00 a.m.	1h30			3	5	33%	67%
Pharmacognosy	42h00	1h30	1h30			3	4	33%	67%
<b>EU methodology</b>									
<b>UEM2(O/P)</b>									
Practical Pharmacology II	42h00			3:00 a.m.		2	4	50%	50%
Supervised project	42h00			3:00 a.m.		2	4	100%	
<b>EU discovery</b>									
<b>UED2(O/P)</b>									
Pharmaceutical technology	9:00 p.m.	1h30				1	2		100%
<b>Cross-cutting EU</b>									
<b>UET2(O/P)</b>									
Computer science for chemistry	9:00 p.m.	1h30				1	1		100%
<b>Total Semester 1</b>	<b>357h00</b>	1:30 p.m.	6:00 a.m.	6:00 a.m.		<b>18</b>	<b>30</b>		

### 3- Semester 3:

Teaching Unit	VHS	VH weekly				Coefficient	Credits	Assessment method	
	14-16 weeks	C	TD	TP	Others			Continuous	Exam
<b>EU fundamentals</b>									
<b>UEF3(O/P)</b>									
Chemistry of heterocycles	63h00	3:00 a.m.	1h30			3	5	33%	67%
Analysis and quality control of medicines	63h00	3:00 a.m.	1h30			3	5	33%	67%
Biostatistics	63h00	3:00 a.m.	1h30			3	5	33%	67%
Galenic pharmacy	42h00	1h30	1h30			3	4	33%	67%
<b>EU methodology</b>									
<b>UEM3(O/P)</b>									
TP analysis and quality control of medicines	42h00			3:00 a.m.		2	4	50%	50%
<b>Methods of extraction and separation of medicinal plants</b>	42h00	1h30		1h30		2	4	50%	50%
<b>EU discovery</b>									
<b>UED1(O/P)</b>									
Polymers Applied to Medicines	9:00 p.m.	1h30				1	2		100%
<b>Cross-cutting EU</b>									
<b>UET1(O/P)</b>									
Bioethics	9:00 p.m.	1h30				1	1		100%
<b>Total Semester 1</b>	<b>357h00</b>	3:00 p.m.	6:00 a.m.	4:30 a.m.		<b>18</b>	<b>30</b>		

#### 4- Semester 4:

Field : Material science

Sector : Chemistry

Speciality : Pharmaceutical Chemistry

Semester S4 is reserved for a practical introductory research internship, culminating in a dissertation and a defense:

UEF1 / 20 credits Coeff. 4

UEM1 / 10 credits Coeff. 2

	VHS	Coefficient	Credits
Personal Work	300	4	20
Internship in a company	/	/	/
Seminars	50	2	10
Other (specify)	/	/	/
<b>Total Semester 4</b>	<b>350</b>	<b>6</b>	<b>30</b>

**5- Overall summary of the training:** (indicate the overall separate VH in progress, TD, for the 04 semesters of teaching, for the different types of UE)

EU VH	UEF	EMU	UED	UET	Total
Course	441h00	9:00 p.m.	63h00	63h00	588h00
TD	252h00	/	0:00	/	252h00
TP	/	9:00 p.m.	0:00	/	9:00 p.m.
Personal work	300h00		/	/	300h00
Seminars	-	50h00	/	/	50h00
<b>Total</b>	<b>993h00</b>	<b>288h00</b>	<b>63h00</b>	<b>63h00</b>	<b>2:07 p.m.</b>
<b>Credits</b>	<b>77</b>	<b>34</b>	<b>06</b>	<b>03</b>	<b>120</b>
<b>% in credits for each EU</b>	<b>64%</b>	<b>28.5%</b>	<b>5%</b>	<b>2.5%</b>	<b>100%</b>

### **III - Detailed program by subject**

## Master's degree title: Pharmaceutical Chemistry

Semester : 01

UEF title: UEF1

Subject title: Advanced organic chemistry

Credits: 5

Coefficients: 3

**Teaching objectives** : To understand the major organic chemistry reactions used in total drug syntheses.

**Recommended prior knowledge:** Basics of organic chemistry

### Content of the subject:

This teaching unit is devoted to the study of major reactions in organic chemistry, polyfunctional products and reaction mechanisms.

- Radical substitution reactions on saturated carbons ;
- Nucleophilic substitution reactions on saturated carbons;
- Addition reactions on unsaturated olefinic compounds;
- Elimination reactions:  $\alpha, \beta, \gamma \dots$
- Aromatic substitution reactions;
- Condensation reactions
- Oxidation and reduction reactions.
- Pericyclic reactions
- Alkylation reactions via enolates
- Rearrangements
- Methods of activation, protection/deprotection of the main functional groups
- Control of stereochemistry.

**Assessment method:** Continuous assessment 33% plus *exam* 67%

**References** *Organic Chemistry Books* .

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 01**

**UEF title: UEF1**

**Subject title: Pharmacology I**

**Credits: 5**

**Coefficients: 3**

**Teaching objectives** : Know the main concepts of pharmacodynamics and pharmacokinetics.

**Recommended prior knowledge** : Basic knowledge of biology

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

- General information: introduction to pharmacology, routes of drug administration.
- Concepts of pharmacokinetics: fate of the drug in the body: the four phases of pharmacokinetics: absorption, distribution, metabolism and elimination.
- Quantification of pharmacokinetics: modeling and parameters of pharmacokinetics: compartment model.
- Pharmacodynamics: Pharmacological targets and mechanisms of drug action
- Quantification of drug effects and pharmacological analysis of the interaction between a drug and its target
- Side effects of medications
- Drug interactions
- Pharmacovigilance

**Assessment method:** Continuous assessment 33% plus *exam* 67%

**References** *Pharmacology Books* .

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 01**

**UEF title: UEF1**

**Subject title: Quantum Chemistry**

**Credits: 5**

**Coefficients: 3**

**Teaching objectives:** Fundamental notions and applications of quantum chemistry models for simulation in pharmaceutical chemistry.

**Recommended prior knowledge:** Theoretical chemistry.

**Content of the subject :**

- A.** Introduction to modeling methods in computational chemistry
- *Schrödinger* wave equation for many-electron systems.
  - *Born-Oppenheimer* approximation
  - Independent electron approximation ( *Man*- body electronic problem)
  - Bosons and Fermions, orbital spin
  - Electron indistinguishability and *Slater determinant*
- B.** Quantum computing methods
- Simple *Hückel* method
  - Molecular orbital (MO) theory  $\pi$  for conjugated polyenes
  - Linear Combination of Atomic Orbitals (LCAO) Method
  - Calculation of charge density, net charge and bond index.
  - *Coulson* formulas for calculating the coefficients of OMs and their energies.
  - Hückel parameters for heteroatoms
- C. Ab initio** methods
- The variational principle
  - **Hartree-Fock** method (SCF-HF self-consistent field)
  - Restricted and unrestricted wave function (RHF-UHF)
  - **Post-Hartree-Fock** methods (electronic correlation)
- D.** Semi-empirical methods (PM3, INDO and CNDO type)
- E.** Density Functional Theory – **DFT**
- Hohenberg-Kohn Approach
  - Approaching Kohn-Sham
  - Atomic orbital bases
- F.** Molecular mechanics

G. Molecular dynamics

- **Theoretical studies of chemical reactivity**

H. Frontier molecular orbitals (FMOs)

I. Pericyclic reactions and the Woodward-Hoffman rule

J. Conrotatory and disrotatory processes

K. Molecular orbital correlation diagrams

## References

- Errol Lewars, Introduction to the Theory and Applications of Molecular and Quantum Mechanics, 2003.
- KI Ramachandan, Computational chemistry and molecular modeling, 2008 springer
- Ian Fleming, Frontier orbitals and organic chemical reactions, 2010 Wiley
- VP Gupta, Principles and Applications of Quantum Chemistry, 2016.
- Donald W. Rogers, Computational Chemistry Using the PC, Third Edition, 2003
- Jean-Louis Rivail, Elements of Quantum Chemistry for the Use of Chemists 1999
- Yves Jean, François Volatron, electronic structure of molecules, 2003

**Assessment method:** Continuous assessment 33% plus *exam* 67%

**References** *Books on Quantum Chemistry and Molecular Modeling* .

## Master's Degree Title: Pharmaceutical Chemistry

Semester : 01

UEF title: UEF1

Subject title: Physicochemical methods of analysis

Credits: 4

Coefficients: 3

**Teaching objectives:** The student acquires theoretical knowledge on molecular spectroscopy in general and the spectroscopic techniques used, the instrumental aspect and applications in analytical and organic chemistry, and in the analysis of drugs.

**Prior knowledge:** The student is expected to know and master the knowledge acquired in chemistry 1 and theoretical chemistry 1 and organic chemistry 1 and 2.

### Content of the subject:

- **Infrared spectroscopy:** Equipment, infrared spectrum, molecular vibrations, IR frequency groups of functional groups, spectrum interpretation.
- **Nuclear magnetic resonance:** magnetic properties of the nucleus, resonance phenomenon, relaxation, detection ( **proton NMR:** chemical shift, nuclear spin coupling, chemical and magnetic equivalence, values of chemical shifts and coupling constants as a function of structure, spin decoupling, heteronuclear coupling. **<sup>13</sup>C NMR:** spectrum, DEPT and APT sequences, correlation between chemical shift and molecular structure, correlation table, spin-spin coupling). **<sup>2</sup>D NMR** .
- **Mass spectrometry:** Equipment, mass spectrum (appearance, molecular peak, determination of molecular mass, isotopic peaks, doubly charged ions, metastable ions, fragmentations and rearrangements, characteristics of mass spectra according to the class of compounds.

**Assessment method:** Reports 33% plus *exam* 67%

**References** *Books on spectroscopy and analysis methods.*

## Master's degree title: Pharmaceutical Chemistry

**Semester : 01**

**EMU title: EMU1**

**Subject title: Organic synthesis practical work**

**Credits: 4**

**Coefficients: 2**

**Teaching objectives:** Students work individually and will implement multi-step syntheses based on the operating procedures provided.

**Recommended prior knowledge:** Organic Chemistry

**Content of the subject:**

- Synthesis of 2-iodobenzoic acid: Sandmeyer-type aromatic substitution reaction
- Synthesis of a coumarin: the Pechmann reaction.
- Synthesis of butyl acetate (Dean-Stark assembly).
- Synthesis of a heterocycle: dihydropyrimidinone, the Biginelli reaction.
- Synthesis of a heterocycle: dihydropyridine, the Hantzsch reaction.
- Oxidation of dihydropyridine to substituted pyridine.

**Assessment method:** 50% reports plus 50% exam

## **References**

- Experimental organic chemistry; M. Chavanne, GJ Beaudoin; Belin editions.
- Organic Chemistry, Methods and Models; Pierre Vogel ; ed., De Boeck.
- handouts, websites, etc.

**Master's degree title: Pharmaceutical Chemistry**

**Semester : 01**

**EMU title: EMU1**

**Subject title: Practical Pharmacology 1**

**Credits: 4**

**Coefficients: 2**

**Teaching objectives :** Learning the routes of administration (oral, intraperitoneal, etc.) and ways of treating animals to avoid stress.

**Prerequisite knowledge:** Pharmacology 1

**Content of the subject:**

- Measuring diuresis in rats using a known diuretic
- Measuring sodium and potassium levels in urine by flame photometry
- Measurement of blood glucose in rats using a hypoglycemic and/or hyperglycemic agent

**Assessment method:** 50% reports plus 50% exam

**References** *Books on experimental pharmacology.*

**Master's degree title: Pharmaceutical Chemistry**

**Semester : 01**

**UED title: UED1**

**Subject title: General Biology**

**Credits: 2**

**Coefficients: 1**

**Teaching Objectives :** The goal is to provide the essential human physiological foundations for future drug specialists. Students will study the physiology of major systems and their regulation.

**Recommended prior knowledge :** Basic knowledge of biology

**Content of the subject:**

The main functions of the human body:

- The cell;
- Kidney function;
- Respiratory function;
- Digestive function;
- The skin;
- Immune system;
- The cardiovascular system;
- The endocrine system;
- The nervous system;
- Reproduction;

**Assessment method:** 100% exam assessment

**References:** *Books on histology, the major functions of the human body and animal biology .*

**Master's degree title: Pharmaceutical Chemistry**

**Semester : 01**

**UET title: UET1**

**Subject title: English**

**Credits: 1**

**Coefficients: 1**

**Teaching objectives:** Understanding scientific documents, writing summaries, giving presentations at conferences or seminars and participating in conferences in English.

**Recommended prior knowledge:** Basic knowledge of English

**Content of the subject :**

- Basic notions of English
- Bibliographic research;
- Synthesis and writing of scientific texts and articles.

**Assessment method:** *100% exam* assessment

**References** *English books and scientific articles in English .*

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 02**

**UEF title: UEF2**

**Subject title: Synthesis strategies and chemistry of heteroelements**

**Credits: 5**

**Coefficients: 3**

**Teaching objectives :** Learn the fundamentals of retrosynthetic analysis and acquire the theoretical and methodological knowledge enabling the use of heteroelements in organic synthesis.

**Recommended prior knowledge:** Organic chemistry

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

#### **Chemistry of heteroelements:**

- Organic derivatives of phosphorus, silicon, tin
- Organic derivatives of boron, selenium, sulfur

#### **Synthesis strategies:**

- General information on retrosynthesis
- CC bond formation using organometallics
- Factors to control in a chemical reaction: chemoselectivity, regioselectivity, stereochemistry
- Retrosynthetic analysis
- Synthesis of alcohols
- Interconversion of functional groups
- Reaction Control: Activation and Protection
- Synthesis of alkenes
- Disconnection of carbonyl compounds
- Synthesis of carboxylic acid derivatives
- Aromatic series disconnection

**Assessment method:** Continuous assessment 33% plus *exam* 67%

**References** *Books on heteroelement chemistry, synthesis strategies and organometallics .*

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 02**

**UEF title: UEF2**

**Subject title: Pharmaceutical Chemistry**

**Credits: 5**

**Coefficients: 3**

### **Teaching objectives :**

**Recommended prior knowledge:** Sufficient knowledge of general and organic chemistry, basic biology.

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

#### **Introduction to Pharmaceutical Chemistry**

- Purpose of pharmaceutical chemistry
- Stages of drug discovery

#### **Fundamental principles guiding drug design**

- Chance discoveries,
- Blind screening,
- Extraction of known active ingredients

#### **Qualitative methods for studying the relationships between structure and activity**

- Structural analogs
- Isosteria
- Bioisostery
- Homologues and vinylogues
- Molecular modeling
- Precursors and metabolites
- Research initiated by knowledge acquired on receptors
- Enzyme inhibitors
- Drugs acting on nucleic acids

#### **Quantitative relationships between structure and activity**

#### **Stereoisomerism and drugs**

- General information
- Conformers
- Geometric isomerism ( *cis* - *trans* or *Z* - *E* )
- Enantiomerism (chirality)

#### **Physicochemical modifications of a drug**

#### **Pharmacokinetic profiles**

#### **Biological consequences of drug-receptor interaction.**

**Assessment method:** Continuous assessment 33% plus *exam* 67%

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

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 02**

**UEF title: UEF2**

**Subject title: Pharmacology II**

**Credits: 5**

**Coefficients: 3**

**Teaching objectives** : The special pharmacology course is devoted to the study of molecules from the main therapeutic classes

**Recommended prior knowledge** : General pharmacology

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

- Cardiovascular drugs
- Drugs acting on the gastrointestinal system
- Respiratory system medications
- Analgesic, antipyretic and anti-inflammatory drugs
- Nervous system drugs
- Hormonal system drugs
- Anti-infectious drugs
- Anticancer drugs
- Immunomodulators

**Assessment method:** Continuous assessment 33% plus *exam* 67%

**References** *Pharmacology books* .

## Master's degree title: Pharmaceutical Chemistry

Semester : 02

UEF title: UEF2

Subject title: Pharmacognosy

Credits: 4

Coefficients: 3

**Teaching objectives:** Study of natural products

**Recommended prior knowledge:** Organic chemistry and general biology

### Content of the subject:

- Introduction
- Primary metabolism compounds (carbohydrates, lipids and proteins)
- Terpenes and steroids (Iridoids, sesquiterpene lactones, essential oils, resins, oleoresins, gum resin, balsams, diterpenes, taxanes, triterpenes, saponosides, raw materials for the steroid industry, cardiogenic heterosides, carotenoids)
- Phenolic compounds (phenols and phenolic acids, coumarins, lignans, flavonoids, anthocyanins, tannins, hydroxyanthracene derivatives, orcinols and phloroglucinols)
- Alkaloids (tropane alkaloids, quinolizidine alkaloids, indole alkaloids, quinoline alkaloids, isoquinoline alkaloids, troponone alkaloids, imidazole alkaloids, diterpene alkaloids, purine bases)
- Proteins (immunomodulators, enzymes, hormones)

**Assessment method:** Continuous assessment 33% plus exam 67%

### References

- BRUNETON J. (2016). *Pharmacognosy: Phytochemistry - Medicinal Plants (5th ed.)*. Lavoisier, Paris.
- Guignard JL, Cosson L., Henry M., preface by Potier P. (1985). *Summary of phytochemistry*. Masson. Paris.
- Crozier A., Clifford MN, Ashihara H. (2006). *Plant Secondary Metabolites Occurrence, Structure and Role in the Human Diet*. Blackwell Publishing. UK.

## Master's degree title: Pharmaceutical Chemistry

**Semester : 02**

**EMU title: EMU2**

**Title of the subject: TP Pharmacology II**

**Credits: 4**

**Coefficients: 2**

**Teaching objectives** : Learning the routes of administration (oral, intraperitoneal, etc.) and ways of treating animals to avoid stress.

**Prerequisite knowledge:** Pharmacology II

**Content of the subject:**

- TP 1: Test on the antioxidant effect
- TP 2: Test on the anti-inflammatory effect
- analgesic effect
- TP 4: Test on the gastrointestinal effect
- TP 5: Microbiological studies (preparation of culture media and antibacterial activity tests)

**Assessment method:** 50% reports plus 50% exam

**References** *Books on experimental pharmacology.*

**Master's degree title: Pharmaceutical Chemistry**

**Semester: 02**

**EMU title: EMU2**

**Subject title: Supervised project**

**Credits: 4**

**Coefficients: 2**

### **Teaching objectives**

Acquisition of instrumental analysis techniques. Knowledge of how the devices work and their areas and limits of application. Design of an analytical protocol.

### **Recommended prior knowledge**

Spectral analysis techniques: IR,  $^1\text{H}$  NMR,  $^{13}\text{C}$ , MS

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

Use of modern instrumental analysis techniques in Research Laboratories and establishing the structure of a molecule by interpreting its spectra

**Assessment method:** 100% reports

**Master's degree title: Pharmaceutical Chemistry**

**Semester : 02**

**UED title: UED2**

**Subject title: Pharmaceutical technology**

**Credits: 2**

**Coefficients: 1**

**Teaching objectives**

The study of galenic pharmacy, which represents the science of transforming active substances into medications. These medications may contain one or more active substances and must be administered in the most suitable form, which most often requires the presence of excipients and packaging selected on scientific grounds.

**Recommended prior knowledge**

Pharmaceutical chemistry and methods of analysis and quality control of drugs.

**Subject content (Pharmaceutical Technology):**

Bioavailability concept, gastrointestinal transit of pharmaceutical forms, physicochemical properties of active ingredients and excipients, solution and dissolution, micellization of surfactants, solid dispersions, notions on the physicochemical stability of substances, dispersed systems (emulsions, suspensions, liposomes, etc.), dermal forms and cutaneous resorption, conventional dry forms (powders, capsules, tablets, etc.), coating and microencapsulation, rectal and vaginal forms, ophthalmic forms, pulmonary forms, nasal forms, injectable preparations, modified release forms (delayed, prolonged) and new pharmaceutical forms (transdermal forms, implants, biodegradable polymers, etc.).

**Assessment method:** *100% exam*

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

**Master's degree title: Pharmaceutical Chemistry**

**Semester : 02**

**UET title: UET2**

**Subject title: Computer science for chemistry**

**Credits: 1**

**Coefficients: 1**

**Teaching objectives :** Good command of IT tools, internet and use of scientific programming language for theoretical chemistry calculations.

**Recommended prior knowledge :** Computer science and basic algorithms.

**Content of the subject :**

**Molecular modeling software** (Gaussian, Auto Dock for Docking, etc.)

- Construction and manipulation of molecules.
- Calculation “Optimization of geometries, charges, frequencies, transition states, IR, Raman, UV spectra, etc.”, visualization of molecular orbitals (HOMO, LUMO and Gap, MEP (Molecular electrostatic potential).
- Study of structural and electronic properties

**Assessment method:** *100% exam*

**References** *Books Theoretical chemistry, molecular modeling and general computing .*

## Master's degree title: Pharmaceutical Chemistry

Semester : 03

UEF title: UEF3

Subject title: Chemistry of heterocycles

Credits: 5

Coefficients: 3

### Teaching objectives :

Studies of heterocycles in organic synthesis and their application in the manufacture of drugs

### Recommended prior knowledge

Organic chemistry.

### Content of the subject :

- Reminders on pyrroles, furans, thiophenes and pyridines
- Azoles: pyrazole groups; imidazoles; oxazoles; thiazoles; triazoles, oxadiazoles; tetrazoles;
- Azines: diazine groups; pyridazines; pyrimidines; pyrazines; benzodiazines;
- diazines containing an oxygen or sulfur atom: oxazine; phenoxazine; thiazines; triazines; tetrazines.
- Aromatic heterocycles with several heteroatoms (purines, pteridines)

\* **For each product we develop:** structure, physicochemical properties, methods of synthesis and semisynthesis, role in biological environments.

**Assessment method:** Continuous assessment 33% plus exam 67%

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

- David T. Davies, *Aromatic Heterocyclic Chemistry* , First edition published in English in 1992.
- René Milcent, *Heterocyclic Organic Chemistry* , EDP Sciences 2003.
- Joule & Mills, *Heterocyclic Chemistry at a Glance* . 2nd ed.2013

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 03**

**UEF title: UEF3**

**Subject title: Analysis and quality control of medicines**

**Credits: 5**

**Coefficients: 3**

**Teaching objectives** : To enable students to choose the most appropriate analytical method for a given problem in the context of analyzing a drug (raw material, related substances, mixed substances).

**Recommended prior knowledge** : *Medicinal chemistry and analytical chemistry.*

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

- Guidelines and regulatory aspects for the quality control of medicines:  
(World Health Organization (WHO) - Pharmacopoeias and Monographs - Agencies European and American Medicines Agency (EMA and FDA) - International harmonization (ICH) - Marketing Authorization (MA) - Good Practices manufacturing (GMP) - good laboratory practices (GLP)
- Purity and stability of drugs and main degradation routes.
- Optimization of analytical procedures.
- Quality control of raw materials.
- Quality control of finished products.
- Quality of magistral and officinal preparations .
- Quality control measurement parameters: pharmacotechnical tests, physical and physicochemical tests, Assay methods, Biological methods.
- Chirality and analysis
- Methods for separation and dosage of drugs in complex media

**Assessment method:** Continuous assessment 33% plus *exam* 67%

**References** *Quality control books .*

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 03**

**UEF title: UEF3**

**Subject title: Biostatistics**

**Credits: 5**

**Coefficients: 3**

**Teaching objectives :** The student will learn the basics of biostatistics and its applications in pharmaceutical chemistry.

**Recommended prior knowledge:** The student is expected to have prior knowledge of basic concepts in algebra, analysis and statistics.

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

- Descriptive Statistics – Probability – Estimation – Confidence Intervals
- Presentation of a set of results relating to a character (notion of frequency distribution, graphical representation).
- Characteristic parameters of a frequency distribution (Typical values of a distribution, dispersion indices of a distribution).
- Theoretical distribution laws and judgment problems on samples.
- Estimation and security of a parameter (generalities, estimation and confidence interval of a mean or a percentage: case of small samples).
- Conformity and homogeneity tests of a set of samples.
- Relationships between two qualitative characteristics (Notions of association and independence) and relationships between two quantitative characteristics (Notions of correlation and regression).
- Hypothesis tests (Principle, hypothesis tests on 1 or 2 means, on 1 or more probabilities, Linear regression and correlation, Basic non-parametric tests, 1 and 2 factor ANOVA, Classical statistical tests and use of the corresponding tables (Z Normal, Student's t, Snedecor's F, chi-square, Q factor), Statistical method for analytical validation.

**Assessment method:** Continuous assessment 33% plus *exam* 67%

**References** *Books on statistics, probability and biostatistics .*

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 03**

**UEF title: UEF3**

**Subject title: Galenic pharmacy**

**Credits: 4**

**Coefficients: 3**

### **Teaching objectives :**

At the end of this course, the student will know the excipients used in the composition of pharmaceutical forms, the operations necessary for their production as well as the principle of their control. This course should in particular allow an understanding of the choice of a galenic form, the methods of its design according to the desired mode of action as well as the characteristics of the active ingredient it contains.

### **Recommended prior knowledge:**

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

**1. Links between formulation and bioavailability.**

**2. Drug development.**

**3. Excipients, adjuvants, colorants and flavorings :** liquid excipients, glycerides, waxes, hydrocarbons and silicones, sugars and derivatives, mineral products, macromolecules, surfactants, preservatives, colorants, sweetening flavors.

**4. Water for pharmaceutical use :** purified water (required quality of purified water, different ways of obtaining purified water, maintenance and disinfection of a demineralization plant and its circuit, controls), water for injectable preparations, required quality of PPI water, different ways of obtaining PPI water, storage of PPI water.

**5. Packaging of medicinal products :** General information (definitions, types, roles, quality criteria of materials and articles). Main packaging materials (glass, plastics, elastomers, metals). General testing of packaging materials (identification, mechanical testing, permeability testing, chemical resistance testing, transparency, safety testing, preservation testing).

**6. Different sterilization methods:** (heat, contact with alkylating gases (ethylene oxide), ionizing radiation, filtration), concept of sterilizing value, sterilization indicators, physicochemical indicators, biological indicators, sterility control, concept of sterility, sterility test, validation of processes (dry heat, moist heat, ethylene oxide, radiosterilization), microbiological validation of sterilization, good sterilization practices.

**7. Pharmaceutical forms for oral administration** (liquid oral forms, tablets; capsules, other solid forms), perlingual administration

**Assessment method:** Continuous assessment 33% plus *exam* 67%.

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 03**

**EMU title: EMU3**

**Subject title: Practical work on analysis and quality control of medicines**

**Credits: 4**

**Coefficients: 2**

**Teaching objectives :** To enable the student to understand the drug in its entirety, from the raw material to the finished product, and thus to put into practice the multidisciplinary of studies in pharmaceutical sciences.

**Recommended prior knowledge:** Analysis methods

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

Practical work constitutes an important part of this master's training. It is organized in one session per week so as to allow students to carry out complete analyses, i.e. from sample preparation to quantification with a calibration line. The first session is devoted to learning the correct use of laboratory equipment (instrument calibration, precise pipetting, etc.) and to carrying out exercises implementing fundamental notions. The other sessions allow students to put into practice concepts seen in the theoretical course (UV, HPLC, GC, electrochemical methods, etc.).

**Assessment method:** 50% report plus 50% exam

**References** *Books on analytical chemistry and chromatographic methods of analysis .*

## **Master's degree title: Pharmaceutical Chemistry**

**Semester : 03**

**EMU title: EMU3**

**Subject title: Methods of extraction and separation of medicinal plants**

**Credits: 4**

**Coefficients: 2**

**Teaching objectives :** To understand the path that leads from the plant to its pure constituents.

**Recommended prior knowledge :** Pharmacognosy, Chromatographic and spectroscopic analysis methods.

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

- **Introduction to herbal medicine :** herbal treatments, herbal medicines, definitions (medicinal plant, herbal drug, secondary metabolites, active ingredient);
- **History of the use of medicinal plants:** empirical period (Civilizations: Sumerian, Chinese, Indian, Egyptian, Greek, Roman, Arab and medieval Europe), scientific period (isolation and study of the activity of plant constituents);
- **Origin and handling of medicinal plants:** raw materials (picked plants, cultivated plants), identification, harvesting, drying, conservation;
- **Forms of use of medicinal plants:** infusions, galenic forms, essential oils, pure constituents, standardization and registration of herbal medicines;
- **Strategies for researching active ingredients:** criteria for choosing a medicinal plant, ancient strategies, modern strategies;
- **Techniques for extracting natural substances:**
  - solid-liquid extraction (Principle, mechanism of extraction, factors influencing extraction performance);
  - extraction of volatile substances (hydrodistillation, saturated steam distillation, hydrodiffusion, expression, Soxhlet, dry distillation, enfleurage, etc.),
  - extraction of non-volatile substances (maceration, infusion, decoction, digestion, etc.),
  - alternative methods (ultrasound-assisted extraction, microwave-assisted extraction, supercritical fluid-assisted extraction, etc.),
  - liquid-liquid extraction (Principle, extraction protocol, etc.);

- **Preparation of enriched extracts:** tests for detecting different secondary metabolites, targeted extractions (alkaloids, irridoids, sesquiterpene lactones, saponosides, cardiotoxic heterosides, phenolic acids, flavonoids, tannins, etc.);
- **Separation of mixtures:** fractionation and purification by chromatographic methods (TLC, paper chromatography, LC, HPLC, GC, etc.);
- **Structural analyses and identification of isolated compounds:** UV, IR, MS, NMR
- **Plants used in therapy .**

**Assessment method:** 50% report plus 50% exam

### References

- BRUNETON J. (2016). Pharmacognosy: Phytochemistry - Medicinal Plants (5th ed ). **Lavoisier, Paris.**
- Satyajit D. Sarker, Zahid Latif, Alexander I. Gray. (2006). Natural Products Insulation (2nd ed ). Totowa, New Jersey.
- Corrado Tringali. (2001). Bioactive Compounds from Natural Sources: Isolation, characterization and biological properties. Taylor & Francis, London.
- Paul Iserin. (2001). Encyclopedia of medicinal plants. Larousse, Paris.

**Master's degree title: Pharmaceutical Chemistry**

**Semester : 03**

**UED title: UED3**

**Subject title: Polymers Applied to Medicines**

**Credits: 2**

**Coefficients: 1**

**Teaching objectives :**

**Recommended prior knowledge : .**

**Content of the subject :**

- Generalities and Definitions
- Classification of polymerization reactions
- Biopolymers and bioresorbable polymers
- Dental materials
- Plastics-Medicines Interactions
- Polymers involved in packaging
- Bioactive macromolecules: Natural or modified polysaccharides - Macromolecules in matrix systems intended for the controlled sequestration/release of active substances – Resorbable macromolecules...Development of chemical or physical hydrogels, behavior depending on external factors (salinity, pH, temperature, etc.).
- Instrumental techniques for characterizing polymers for pharmaceutical use

**Assessment method:** *100% review*

**References** *Books Theoretical chemistry, molecular modeling and general computing .*

**Master's degree title: Pharmaceutical Chemistry**

**Semester : 03**

**UET title: UET3**

**Subject title: Bioethics**

**Credits: 1**

**Coefficients: 1**

**Teaching objectives :** Identify ethical issues that arise in the fields of biology, health care and life sciences, to justify ethical decisions rationally.

**Recommended prior knowledge :**

**Content of the subject:**

Definition of bioethics.

History of Science and Bioethics

Principles of bioethics

Areas of bioethics

The integration of bioethics and science

International texts: Evolution of the legal framework (bioethics laws)

Medical ethics and social ethics

**Assessment method:** 100% exam

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

## V- Agreements or conventions: no

### STANDARD LETTER OF INTENT

Subject: Approval of co-sponsorship of the master's degree entitled:

The university (or university center) hereby declares to co-sponsor the above-mentioned master's degree throughout the accreditation period of this master's degree.

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

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

SIGNATURE of the legally authorized person:

FUNCTION :

Date :

### STANDARD LETTER OF INTENT

**SUBJECT:** Approval of the project to launch a master's course entitled:

Provided to:

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

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

- To give our point of view in the development and updating of teaching programs,
- Participate in seminars organized for this purpose,
- Participate in defense juries,
- Facilitate as much as possible the reception of interns either in the context of final-year dissertations or in the context of supervised projects.

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

Mr (or Mrs).....is designated as external coordinator of this project.

SIGNATURE of the legally authorized person:

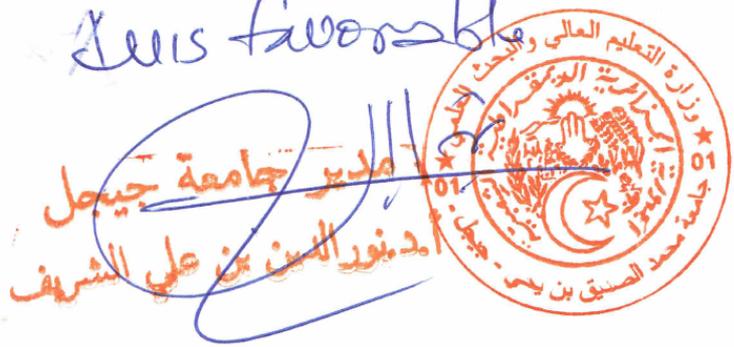
**FUNCTION :**

**Date :**

**OFFICIAL STAMP or COMPANY SEAL**

## **VI - Opinions and Visas of the Administrative and Consultative Bodies**

**Master's degree title: Pharmaceutical Chemistry**

Chef de département + Responsable de l'équipe de domaine	
Date et visa	Date et visa
 <p>رئيس قسم الكيمياء حاروشة</p>	 <p>ميدان التكوين: علوم المادة أ.د. خليلي اسماعيل</p>
Doyen de la faculté (ou Directeur d'institut)	
Date et visa :	
 <p>عميد الكلية بالنيابة أ.د. بوزالوي نور الدين</p>	
Chef d'établissement universitaire	
Date et visa	
<p>avis favorable</p>  <p>مدير جامعة جيجل أ.د. نور الدين بن علي الشريف</p>	

**VII – Notice and Visa of the Regional Conference  
(Only in the final version sent to the MESRS)**

**VIII – Opinion and Visa of the National Educational Committee of the  
Domain  
(Only in the final version sent to the MESRS)**