

COURSE GUIDE
Pharmaceutical Chemistry 1
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Grado (Bachelor's Degree)	Bachelor's Degree in Pharmacy	Branch	Health Sciences				
Module	Química	Subject	Química Farmacéutica				
Year of study	3 ^o	Semester	2 ^o	ECTS Credits	6	Course type	Compulsory course

PREREQUISITES AND RECOMMENDATIONS

The students should have studied the following subjects:

- Organic Chemistry I and II
- Biochemistry
- Pharmacology
- Pharmaceutical Chemistry I

BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

Design, synthesis and drug analysis

SKILLS
GENERAL SKILLS

- CG01 - Identificar, diseñar, obtener, analizar, controlar y producir fármacos y medicamentos, así como otros productos y materias primas de interés sanitario de uso humano o veterinario.

SUBJECT-SPECIFIC SKILLS

- CE01 - Identificar, diseñar, obtener, analizar y producir principios activos, fármacos y otros productos y materiales de interés sanitario
- CE03 - Llevar a cabo procesos de laboratorio estándar incluyendo el uso de equipos científicos de síntesis y análisis, instrumentación apropiada incluida.
- CE04 - Estimar los riesgos asociados a la utilización de sustancias químicas y procesos de laboratorio.
- CE08 - Conocer y comprender la naturaleza y comportamiento de los grupos funcionales en moléculas orgánicas.



- CE09 - Conocer el origen, naturaleza, diseño, obtención, análisis y control de medicamentos y productos sanitarios.
- CE11 - Conocer y aplicar las técnicas principales de investigación estructural incluyendo la espectroscopia.

TRANSFERABLE SKILLS

- CT02 - Capacidad de utilizar con desenvoltura las TICs

LEARNING OUTCOMES

The student should learn, know and understand:

- The theoretical content included in the subject
- The necessary operations in a laboratory of organic synthesis for the synthesis and isolation of drugs, and their analysis and structural determination (spectroscopical and chemical methods).
- The necessary abilities for drug design, use of molecular models and drawing structures with the computer

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

- **Chapter 1. Concepts in Pharmaceutical Chemistry.**
 - Basic concepts and aims of Pharmaceutical Chemistry. From biological raw material to drug. Drug and medicine. Relationships between Pharmaceutical Chemistry and other sciences. Patents.
- **Chapter 2. Classification and nomenclature of drugs.**
 - Nomenclature of drugs: types. Systematic Nomenclature: IUPAC rules. International Nonproprietary Name (INN). Others.
- **Chapter 3. Search of lead compounds.**
 - Traditional discovery of new drugs: major procedures. Drug discovery today. Stages in the development of a drug.
- **Chapter 4. Optimization of lead compounds.**
 - Qualitative structure-activity relationships: structural modification as an optimization tool. Biologically exchangeable groups: bioisosteres. Generalization of the concept: peptidomimetics.
- **Chapter 5. Biological targets and drugs receptors.**
 - Biological targets and receptors: drug-receptor interactions and molecular recognition. Stereochemistry of drugs. Affinity and efficacy of a drug. Pharmacophore group concept.
- **Chapter 6. Drug metabolic processes: other methodologies in the discovery of new drugs.**
 - Phase I metabolic processes of drugs. Phase II metabolic processes of drugs. Use in drug discovery. Prodrug concept, hard drugs and soft drugs. Bioreversible drugs design, bioprecursors and molecular transporters.
- **Chapter 7. Quantitative Drug Design: parameters and quantitative structure-activity relationships.**



- Introduction to quantitative structure–activity relationships. Parameters used in QSAR. Introduction to molecular modeling. Other techniques used in new drugs design.
- **Chapter 8. Enzymatic inhibition: Inhibitors of cell wall biosynthesis.**
 - Enzymatic inhibition as a source of new drugs. Structure of β -lactam antibiotics as peptidoglycan inhibitors biosynthesis. Preparation of 6-APA and 7-ACA. Semisynthetic β -lactam compounds: penicillins and cephalosporins. Introduction to drug analysis. Penicillins and cephalosporins structural recognition methods.
- **Chapter 9. Enzymatic inhibition: Other antibacterial agents.**
 - Sulfonamides: Origin, acidity and structure–activity relationships. Other related sulfonamides and analogues. Others antibacterial drugs.
- **Chapter 10. Enzymatic inhibition: antitumor and antiviral drugs.**
 - Structure and synthesis of purines and pyrimidines antitumor analogs. Structure and synthesis of antiviral drugs. Other synthetic antitumor drugs.

PRACTICAL SYLLABUS

- Practice 1. Phenytoin synthesis.
- Practice 2. Theophylline synthesis.

RECOMMENDED READING

ESSENTIAL READING

- Fundamentos de Química Farmacéutica I: Teoría y Ejercicios. Ed. Técnica Avicam, 2019.
- J. Campos Rosa y M.E. Camacho Quesada. Pharmaceutical Chemistry, vol 1: Drug design and action.
- Campos Rosa y M.E. Camacho Quesada. Pharmaceutical Chemistry, vol 2: Drugs and their biological targets.
- C. Avendaño. Introducción a la Química Farmacéutica. Ed. Interamericana–McGraw–Hill. (2ª Ed.) Madrid 2001.
- W. O. Foye. Principios de Química Farmacéutica. Ed. Reverté. Barcelona. 1988. (7ª Ed. en inglés: Lea and Febiger. Filadelfia. 2013).
- Korolkovas. Fundamentos de la Química Farmacéutica. Ed. Reverté. Barcelona 1978. (Ed. En inglés: Wiley. Nueva York. 1988).
- A. Delgado y col. Introducción a la Química Terapéutica. Ed. Díaz de Santos. (2ª Ed.) Barcelona 2003.
- S. Cuéllar. Introducción a la Química de los Medicamentos. Ed. CGCF. Madrid 1999.
- T. Nogrady. Medicinal Chemistry. A Biochemical Approach. Ed. Oxford University Press. Oxford 1988.
- G. L. Patrick. An Introduction to Medicinal Chemistry. Ed. Oxford University Press. Oxford, 2013.
- E. Raviña Rubira. Medicamentos Un viaje a lo largo de la evolución histórica del descubrimiento de fármacos. Ed. Universidad de Santiago de Compostela. 2008.

COMPLEMENTARY READING

- D. Lednicer. Organic Chemistry of Drug Synthesis. Vols. 1–6. Ed. Wiley. New York 1977–1999.



- D. Mauleón y A. Delgado. Nomenclatura química sistemática de los fármacos. Ed. PPU. Barcelona 1987.
- C. Avendaño. Ejercicios de Química Farmacéutica. Ed. Interamericana-McGraw-Hill. Madrid 1997.
- P. Camps García. Fundamentos de síntesis de fármacos. Ed. Universidad de Barcelona. 2005.

TEACHING METHODS

- MD01 Lección magistral/expositiva
- MD03 Resolución de problemas y estudio de casos prácticos
- MD04 Prácticas de laboratorio y/o clínicas y/o oficinas de Farmacia
- MD07 Seminarios
- MD10 Realización de trabajos individuales
- MD12 Tutorías
- MD13 Participación en plataformas docentes

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET

GENERAL ASSESSMENT CRITERIA FOR APPLICATION TO ALL EXAM TESTS

1. The evaluation tests and their percentages for the final grade used during the academic year will be established by the professor or professors of the subject at the beginning of the course from among those indicated in this Teaching Guide (see **Table 1** and **Table 2**).
2. In ALL the evaluation tests the student must show a minimum and uniform knowledge of all the proposed questions, as well as the necessary skills. The minimum knowledge is reached by obtaining a 5 in all the questions or blocks of the exam.
3. In exceptional cases or if there is any doubt about the authenticity of the assessment exercises, and according to the teacher's criteria, complementary oral tests may be carried out to justify the student's knowledge. These tests will be governed by the evaluation criteria described in section 2.

Table 1. Assessment systems and their percentages in the final grade for the Continuous Assessment mode.

	EVALUATION SYSTEMS	% FINAL SCORE a
Final exam	SE.1, SE.2, SE.3 and SE.4	70
Midterm exam	SE.1, SE.2, SE.3 and SE.4	15-30
Practices, preparation and/or presentation of works	SE.7, SE.8, SE.9, SE.10, SE.5, SE.11, SE12 and SE15	0-15
Assistance	SE.15	0-5

a The percentages in the final grade will depend on the criteria established at the beginning of the course by the professor/professors of the subject.



Table 2. Information codes of the different evaluation systems.**EVALUATION SYSTEMS**

SE.1 Written developmental exams	SE.9 Practice exams by an oral test
SE.2 Short answer written exams	SE.10 Preparation of report or notebook of practices
SE.3 Multiple choice written exams	SE.11 Preparation of a group work
SE.4 Oral tests	SE.12 Individual work preparation
SE.5 Exhibition of works	SE.13 Self appraisal
SE.6 Presentation of topics	SE.14 Field tests
SE.7 Practice exams through a practical test	SE.15 Assistance
SE.8 Practice exams by a written test	

The Student Assessment and Qualification Regulations of the University of Granada (<https://goo.gl/uHfqJy>) establish two main assessment modalities: **Continuous Assessment** (preferred) and **Single Final Assessment**.

CONTINUOUS ASSESSMENT**THEORY**

1. The **Continuous Assessment** of the subject will consist of:
 - A **midterm exam** (see date in the Academic Calendar) that is not eliminatory and whose percentage for the final grade will be established by the professor or professors of the subject at the beginning of the course, based on those established in **Table 1**.
 - A mandatory **final exam** (see date in the Academic Calendar) that must be passed with a minimum grade of 5, and whose percentage for the final grade will be established by the professor or professors of the subject at the beginning of the course, depending on the established in **Table 1**.
 - The **final grade** will be obtained by adding the marks obtained in the **midterm exam** and **the final exam**, as well as in any other evaluation test that the professor establishes at the beginning of the course, as long as in the final exam has been obtained a minimum rating of 5.
2. The subjects whose teaching is taught jointly by two or more professors will be governed by the following criteria:
 - Each part will be evaluated independently.
 - The different parts may have a different weighted value in the final grade that will depend on its length.
 - It will be mandatory to obtain a minimum grade of 5 in each of the parts in order to pass the course.
 - For the final grade of the subject, a weighted average of the grades obtained in the different parts will be made, provided that the previous criterion is met.
 - The evaluation of each of the parts will be carried out using the General Evaluation Criteria initially described.
3. None of the passed exams will be saved neither for the extraordinary exams nor for subsequent academic courses.

PRACTICES

1. It is mandatory to pass the practices in order to pass the course.
2. The student must attend ALL the practical sessions as well as take and pass a knowledge test from among those described in the Assessment Systems (Table 2), or a combination of these, according to the professor's criteria.
3. In order to better weigh the grade or in the event of any reasonable doubt about the individual work carried out by the student, as well as about the knowledge acquired during the development of practical teaching, the teacher may take oral tests and / or INDIVIDUAL practices COMPLEMENTARY that will be governed by the evaluation criteria described in section 2 of the General Evaluation Criteria section.
4. The students summoned to practices as substitutes have the obligation to attend the day of the call at the indicated time. The student who does not justify his absence adequately will not be summoned again.
5. The practices approved in an academic year will not be saved for subsequent academic courses or for extraordinary calls, the student having to take another exam of practices in said call.
6. Students who have not taken all the practical classes or have not passed them, will not be able to pass the subject in the continuous (ordinary) assessment, and must take a theoretical-practical exam in the laboratory in the extraordinary call.

EXTRAORDINARY EXAMINATION DIET

Students who have not passed the subject in the ordinary call will have an extraordinary call. All students may attend it, regardless of having followed a continuous assessment process or not. Students will have to take and pass, in addition to the theoretical exam, a practical exam in the laboratory. Both tests will be governed by sections 2 and 3 of the General Evaluation Criteria established in this Teaching Guide.

SINGLE FINAL ASSESSMENT (evaluación única final)

The Regulations for the Evaluation and Qualification of Students of the University of Granada (<https://goo.gl/uHfqJy>) contemplates the realization of a **Single Final Evaluation** to which those students who for work reasons, health, disability or any other duly justified cause cannot comply with the **Continuous Evaluation** method.

To qualify for the single final evaluation, the student, in the first two weeks of teaching the subject or in the two weeks following enrollment if it has occurred after the start of the subject, will request it through the electronic procedure, to the Director of the Department alleging and proving the reasons that assist him for not being able to follow the continuous evaluation system. The Director of the Department to which the request was addressed, after hearing the teaching staff responsible for the subject, will resolve the request within 10 business days. Once this period has elapsed without the student having received an express written response, the request will be deemed estimated.

Students who choose this system will have to take and pass a theoretical exam and a practical exam in the laboratory that will be governed by section 2 of the General Evaluation Criteria established in this Teaching Guide.

ADDITIONAL INFORMATION

II. EVALUATION BY INCIDENTS FOR PARTIAL TESTS AND FINAL TESTS IN ORDINARY AND EXTRAORDINARY CALL



Incident Assessment is regulated in Article 9 of the Regulations for the assessment and qualification of students at the University of Granada.

For the evaluation request for incidents for partial and/or final tests of this subject, both in ordinary and extraordinary call, the following procedure must be followed:

1. APPLICATION

It is requested in writing, with a form of various requests, in the Registry of the Secretariats of the Centers or in the Electronic Registry of the UGR (<https://sede.ugr.es/procs/Registro-Electronico-de-la-UGR-Solicitud-generica/>).

The request must include the **postal address and email address** of the person concerned, for the purposes of notifications. **Requests made by email are not allowed.**

The incidents dealt with, the deadline for making the request and the documentation to be submitted are detailed below:

- **Incidence 1** - Coincidence of date and time for reasons of attendance at collegiate government bodies or university representation. **Term:** From the receipt of the call to the date of the exam. **Documentation to present:** Original of the call.
- **Incidence 2** - Coincidence with official activities of high-level and high-performance athletes or by participation in sports activities of an official nature representing the University of Granada. **Term:** At least **10 business days** in advance of the exam date. **Documentation to present:** Official documentation that proves such circumstance.
- **Incidence 3** - Coincidence of date and time of two or more evaluation procedures of subjects of different courses and/or degrees. **Term:** At least **10 business days** in advance of the exam date. **Documentation to present:** The exams must be in an official call.
- **Incidence 4** - In cases of illness duly justified through an official medical certificate. **Term:** With a minimum notice of **5 calendar days before or up to 5 business days after** the date of the exam. **Documentation to present:** Official medical certificate.
- **Incidence 5** - Due to the death of a relative up to the second degree of consanguinity or affinity, which occurred in the ten days prior to the scheduled date for conducting the test. **Term:** Up to **5 calendar days** after the date of the exam. **Documentation to present:** Official death certificate and proof of the degree of relationship.
- **Incidence 6** - Due to the beginning of an outgoing mobility stay at a destination university whose academic calendar requires the incorporation of the student on dates that coincide with the evaluation test dates. **Term:** At least **20 business days** in advance of the exam date. **Documentation to present:** Mobility scholarship holder's credential and accreditation of the date on which they must be at the destination.

2. RESOLUTION OF THE APPLICATION

The resolution of the request by the Department is notified to the interested person, at the physical address or email (either of the two) indicated in the request made.

If the application is accepted by the Department, the Professor of the Group that teaches the implied subject is also notified.

The notification must be made within a **period not exceeding 2 business days** after the resolution.

3. PROCEDURE AND DEADLINES AFTER THE RESOLUTION OF THE APPLICATION



The student with an accepted application resolution must contact the Professor within a period that should **never exceed 12 calendar days** after the date of the resolution of his application. For this purpose, the use of e-mail is allowed, putting as the sending address the UGR e-mail address of the Professor of the subject for which the incident assessment is requested, and the e-mail address of the Department Director.

If after this period the student has not contacted, it is understood that they have waived the evaluation for incidents requested and it will be recorded as "Not presented" in the evaluation grade and/or in the corresponding Records.

Once the student has contacted the Professor, they continue according to the procedure established in Article 9 of the Regulations for Evaluation and Qualification of students at the University of Granada.

4. EVALUATION FOR INCIDENTS BY COINCIDENCE IN DATE AND TIME OF TWO OR MORE EVALUATION PROCEDURES

In the event that the reason for the evaluation request due to incidents is due to the coincidence of the date and time of two or more evaluation procedures for subjects of different courses and / or degrees, the student must after his request:

1. Proof of having presented and taken the final test of the coincident subject established in its official announcement, by means of a form model that can be requested at the Department Secretary and that must be signed by the professor of said subject and stamped by the corresponding Department.
2. Deliver this receipt to the teacher responsible for carrying out the incident evaluation.

If the student does not appear for the first of the exams affected by the incident, he will lose his right to be evaluated in the call for evaluation by incidents for the second exam. In other justified cases, the cause of force majeure and / or supervening that has prevented the examination on the official date must be duly proven. The resolution of applications based on the coincidence of date and time of two or more evaluation procedures of subjects of different courses and / or degrees, is carried out according to the procedure established in Agreement 2/COA 05-08-2020 of the Faculty of Pharmacy.

In all the above cases, the acceptance of an evaluation request for incidents implies the resignation of the student to appear on the date of the corresponding official call established in the exam calendar.

II. GRADING SYSTEM

In the case of subjects whose Teaching Guides include a final exam that represent 50% or more of the total weighting of the final grade for the subject and the student decides not to take it, it will appear in the minutes with the annotation of "Not presented". When the student has carried out activities and tests of the **Continuous Assessment** process contemplated in the Teaching Guide of the subject that constitute more than 50% of the total weighting of the final grade for the subject, they will appear in the records with the corresponding grade.

