VNIVERSITAT DE VALÈNCIA

Course Guide
34100 New Perspectives in Pharmaceutical Design and Synthesis

COURSE DATA

Data Subject	
Code	34100
Name	New Perspectives in Pharmaceutical Design and Synthesis
Cycle	Grade
ECTS Credits	4.5
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1201 - Degree in Pharmacy	Faculty of Pharmacy and Food Sciences	5	First term

Subject-matter

Degree	Subject-matter	Character
1201 - Degree in Pharmacy	33 - New perspectives in drug design and synthesis	Optional

Coordination

Name	Department
DIAZ OLTRA, SANTIAGO	325 - Organic Chemistry

SUMMARY

The subject “New perspectives in drug synthesis and design” is a six-month optative subject formed by 4.5 credits within the new Syllabus for the degree of Pharmacy.

The main objective is acquiring the knowledge of the usual methodology employed in the design and synthesis of drugs in enantiomerically pure form. Therefore, a sound background in the distinct methodologies that give access to chiral drugs is required for a good comprehension. Those initial ideas will later be applied to industrial drug synthesis, focusing specifically in the most often used methodologies, together with the problems encountered and the way to overcome them. A second aspect to consider is peptide chemistry, since these molecules are essential from both, a biological and a chemical point of view. In this context, the problems associated with peptide synthesis, such as the use of protecting groups are important points to consider. Nowadays, one of the main topics related to peptide chemistry is solid phase synthesis, together with the biological-mediated procedures to access them. The most important features of this methodology will be discussed in detail. Thus, in this section significant examples in the synthesis of peptides and peptidomimetics will be employed to describe the current strategies in peptide synthesis.

An alternative approach to the synthesis of chiral drugs, is based in transition metal-mediated enantioselective catalysis. Although the principles that govern this type of catalysis are beyond the scope of this subject, the exposition of the basic principles and the study of representative examples involving both homogeneous and heterogeneous catalysis will be discussed. In this sense, the catalytic cycle of the most common cross-coupling reactions will be treated in detail. Another important aspect in the industrial production of drugs is their environmental impact, so the basic principles of the so-called 'green chemistry' will be discussed and practical examples of its implementation will be analysed. In the last part of the subject several practical examples of the synthesis of drugs on an industrial scale, the basic principles of molecular modeling and the spectroscopic methods currently employed in the synthesis and identification of drugs will be described.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Basic knowledge of Organic Chemistry, both theoretical (chemical structure, reactivity of functional groups, and synthetic methodology) and practical (knowledge of laboratory techniques of organic chemistry). Basic knowledge of structural Biochemistry.

OUTCOMES

1201 - Degree in Pharmacy

- Skill to communicate ideas, analyze problems and solve them with a critical mind, achieving team-working abilities and assuming leadership whenever required.
- Facility to obtain and analyze information to face scientific problems.
- Ability to pursue continuous training during professional development.
- Knowledge of the advanced spectroscopical techniques and their application in drug development and active ingredients research
- Understanding of the pharmaceutical industry insights and the most relevant aspects of process chemistry (multigram scale synthesis)
- Ability to design synthetic sequences for the preparation of some active ingredients, by using methodologies previously described along the course.
- Molecular modeling performing of simple organic structures taking advantage of suitable software.

LEARNING OUTCOMES

After completing the theoretical as well as the practical aspects of the course, the student will be able to:

* Use basic scientific terminology related to the subject properly.
*Express understanding and knowledge of the facts, concepts, principles, and basic theories related to the contents of the course.
*Apply this knowledge to understand and solve problems in daily life.
*Present scientific work properly.
*Integrate knowledge on drugs synthesis with that obtained in other subjects.
*Develop laboratory processes.
*Evaluate, interpret the mode of action, and synthesize drugs.
*Recognize and apply the scientific method.
*Understand and interpret scientific papers related to the subject.

DESCRIPTION OF CONTENTS

1. Research and development in pharmaceutical industry processes

1. Introduction: Characteristics of the current pharmaceutical industry. Study methods of drug interactions with biomolecules (NMR, X-rays, computational methods, ...). 2. Asymmetric synthesis: Synthesis of enantiomerically pure drugs. Strategies and examples. 3. Metal-catalysed cross-coupling reactions. 4. Synthesis of peptides and protecting groups: Design of a synthesis. Retrosynthetic analysis. Synthesis in homogeneous and heterogeneous phase. 5. Green chemistry: Aspects to consider when selecting a synthetic route. Equipment and process safety. Reagents of choice and solvents. The presence of water in the processes. Online detection. 6. Process development: From small-scale production to industrial synthesis. Examples.

2. Informatic Workshop

Computer tools in drug design: Molecular modeling. Introduction and examples. Use of suitable software.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	28,00	100
Seminars	7,00	100
Computer classroom practice	6,00	100
Tutorials	2,00	100
TOTAL	**43,00**	

TEACHING METHODOLOGY

Theoretical Lectures- Students must acquire basic knowledge included in the syllabus through self-study and attendance at the lectures. In those lectures, the teacher will give an overview of the topic under study with special emphasis on the most relevant aspects and in those of special complexity. To encourage the active participation of student the Professor will alternate the expositive method (lecture), case study and the posing of problems. For individual study and preparation of the issues in depth, students will be provided with the appropriate bibliography and the necessary support material.

Seminars and Problems .- In it mainly take place resolution of problems before known to be prepared and presented by the students themselves. The small number of students in each subgroup will facilitate more active participation.

In addition to this type of problem-solving seminar, complementary activities on topical issues related to the subject may carry out (debates, analysis of readings, press releases), or delve into some specific aspect of the topics whose understanding it more difficult, if this is required by students.

Tutorials.- The tutorials are organized in small groups of students, according to the timetable set (2 in total throughout the term). In them, the teacher will evaluate the process of student learning in a globalized manner . To do so may raise individually or collectively more complex specific issues to that resolved in the seminars, according to the needs of students. Tutorials also be used to resolve the doubts that have arisen over the lectures and advising students on strategies to follow to avoid the difficulties that they may have.

Practical classes (chemoinformatics).- in this section students will learn to use IT programs related with the contents of the subject as well as gathering relevant information by means of access to the internet.

EVALUATION

In the evaluation of student learning all aspects outlined in the methodology section of this guide will be considered and assessed continuously by the teacher.

10% of the score (1 point) come from the direct evaluation by the teacher, the result of contact with the student in the various forms of programmed learning. Various aspects such as participatory attendance, progress in the use of language characteristic of matter, critical thinking, ability to work with the rest of the group, and participation in seminars will be taken into account. It will also be possible to carry out some voluntary tutoring activity for students from previous courses, on organic chemistry issues and its relationship with the Sustainable Development Goals (SDGs), which will be valued positively in the grade.

10% of the grade (1 point) for the seminar- presentation. This mark will be considered only if the student has passed the theoretical exam and laboratory practices.

80% of the grade (8 points) is derived from the results obtained in the written tests and examinations. It will be possible to carry out some written test on computer science practices, approximately towards the end of November. There will be one written exam to be held on the dates established by the Faculty. The exam will consist of material issues and questions that require students to relate aspects of the subject appearing in the various sections or, complementing those previously studied in other subjects. Students who do not pass the first examination session will have a second opportunity in the same academic year.

To pass the subject is required to obtain a rating of at least 5 out of 10.

REFERENCES

Basic

- Practical Process Research & Development. A Guide for organic chemists. 2nd Edition. Neal G. Anderson, Academic Press, 2012
- Introducción a la síntesis de fármacos. A. Delgado, C. Minguillón, J. Joglar Editorial Síntesis
- Introducción a la Química Farmacéutica. C. Avendaño. 2ª Edición Mc Graw Hill
- Transition metals in the synthesis of complex organic molecules, 2nd Ed., L. S. Hegedus, University Science Books, 1999
- Green Chemistry in the Pharmaceutical Industry. Edited by P.J. Dunn, A.S. Wells and M.T. Williams. WILEY-VCH, Weinheim, 2010

Additional

- Process Development, Fine Chemicals from Grams to Kilograms, S. Lee y G. Robinson, Oxford Science Publications, OUP 1995
- From Bench to Market, W. Cabri, R. Di Fabio, OUP 2000
- Chirality in Industry I and II, A.N. Collins, G.N. Sheldrake y J. Crosby, John Wiley & Sons Ltd. 1994, 1997

- Organic Synthesis, C. Willis y M. Willis, Oxford Science Publications, OUP 1997
- The Art of Drug Synthesis. Edited by D.S. Jhohnson and J.J. Li. John Wiley & Sons, Inc., 2007

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Contents

The contents initially collected in the teaching guide are maintained.

Volume of work and temporary planning of teaching

The different activities described in the Teaching Guide are maintained with the planned dedication.

Teaching methodology

All aspects cited in the guide are maintained. The teaching material necessary for the development of the activities will be uploaded to the virtual classroom.

Face-to-face teaching can be reinforced by:

Proposal of activities for virtual classroom

Videoconference

Powerpoint with oral explanations

Videoconference tutoring

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes of the subject, these will be replaced by non-contact sessions following the established schedules.

Evaluation

The criteria included in the teaching guide are maintained.

If there is a closure of the facilities for health reasons that affect the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade for the course will remain unchanged, as established in this guide.

Bibliography

The bibliography recommended in the Teaching Guide is maintained.