SUBJECT GUIDE Academic year 2016-2017

Advanced Chemistry of Drugs

Module	Content	Year	Term	Credits	Type
Chemistry	Advanced Chemistry of Drugs	5º	1º	6	Optional

Lecturer	Postal address, telephone nº, e-mail address
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Degree within which the subject is taught	Other degrees	Tutorial
Degree in Pharmacy	Chemistry	Tuesday and Thursday, 10:30-13:30

Prerequisites and/or recommendations

The students should have enough background in:

- Organic Chemistry
- Medicinal Chemistry

Brief account of the subject program (according to the degree)

The synthesis of advanced chemical moieties related to drugs

General and particular abilities

A. General abilities:
CG1 Identification, design, synthesis, and analysis of drugs and the corresponding intermediate chemicals.
B. Specific abilities:
CEM1.3 The use of standard organic chemistry protocols these including the use of organic synthesis equipment, and analysis equipment.
CEM1.4 Evaluate the risk concerning the manipulation of chemicals and protocols.
CEM1.5 Acquire the knowledge of the chemical properties for substances used during drug production.
CEM1.9 Analysis and control of drugs and related products.
CEM1.11 Increase the knowledge and the applicability of structural technics including spectroscopy.

Objectives (expressed in terms of expected results of the teaching program)

The student should increase the knowledge of the synthesis of chemical moieties related to drugs, focusing in the following main topics:

- Strategies for the synthesis of valuable intermediates during drug preparation
- The use of enzymes in the preparation of valuable intermediates during drug synthesis
- The synthesis and separation of enantiomers

Detailed subject chapters

Chapter 1. General concepts.

Linear and convergent synthesis. Importance of the optimization of the synthetic procedure.

Chapter 2. Synthetic strategies I

Disconnections and retrosynthetic analysis. Retrosynthesis of mono- and di-functional molecules

Chapter 3. Synthetic strategies II

Asymmetric synthesis. Racemic resolution. Representative examples of asymmetric drug synthesis.

Chapter 4. Synthetic strategies III

The organometallics in drug synthesis. C-C bond and C-heteroatom bond formation. Representative examples of drug synthesis using organometallics.

Chapter 5. The synthesis of common ring fragments found in drugs

Aromatic and non-aromatic heterocycles. Representative examples of the cyclic moiety synthesis found in drugs.

Chapter 6. The chirality in the pharmaceutical industry

The use of enzymes in organic synthesis. Representative examples.

Chapter 7. Solid-phase synthesis

The peptide synthesis on solid phase. The synthesis of peptidomimetics. Concepts on combinatorial organic chemistry. Importance of the combinatorial chemistry in drug synthesis.

Chapter 8. Stability and quantification of drugs

Factors involving the stability of drugs. Methods for drug quantification. The identification and quantification of active substances and the metabolites in drugs and biological fluids.

Experimental work

Practice 1. The synthesis and analysis of (*R*,*S*)- and (*S*)-ibuprofen

Practice 2. The synthesis of sulfasalazine

Reading

- Delgado, C. Minguillón, J. Joglar. Introducción a la Síntesis de Fármacos. Editorial Síntesis, **2003**.
- Wyatt, P.; Warren, S. Organic synthesis: strategy and control. John Wiley & Sons, **2007**
- Lednicer, D. The organic chemistry of drug synthesis (Vol. 7). Editorial John Wiley & Sons, **2008**.
- S. Warren, P. Wyatt. Organic Synthesis. The disconnection Approach. 2ª Ed. Editorial Wiley, **2008**.
- Li, J. J.; Johnson, D. S. Modern drug synthesis. Editorial Wiley, **2010**
- Johnson, D. S.; Li, J. J. The art of drug synthesis. Editorial Wiley, **2007**
- Steven A. Kates, Fernando Albericio. Solid-Phase Synthesis: A practical guide. Dekker, **2000**
- Lin, G.; You, Q.; Cheng, J. Chiral drugs: Chemistry and Biological action. Editorial Wiley, **2011**
- Kurt Faber. Biotransformations in Organic Chemistry: A Textbook Springer
- Agranat, H. Caner, J. Caldwell. Putting chirality to work: the strategy of chiral switches. Nature Reviews/Drug Discovery **2002**, 1, 753-768.
- Ahuja, S.; Rasmussen, H. HPLC Method Development for Pharmaceuticals. Academic Press, **2007**

Other

- Vardanyan, R. S.; Hruby, V. J. Synthesis of essential drugs. Editorial Elsevier, **2006**
- Ganapathy Subramanian. Chiral separation techniques. Wiley-VCH **2007**
- R. Mannhold, H. Kubinyi, Timmerman, H. Combinatorial Chemistry. Wiley-VCH **2000**
- Paul Lloyd-Williams, Fernando Albericio, Ernest Giralt. Chemical Approaches to the Synthesis of Peptides and Proteins. CRC Press **1997**

Recommended internet links

Departamento de Química Farmacéutica y Orgánica (http://www.ugr.es/~qfo/inicio.html)
IUPAC Nomenclature of Organic Chemisty (http://www.acdlabs.com/iupac/nomenclature/)
Chemistry Guide (http://www.chemistryguide.org/index.php)
Journal of Medicinal Chemistry (http://pubs.acs.org/journal/jmcmar)
European Journal of Medicinal Chemistry (http://www.nature.com/nrd/index.html)
Nature Reviews Drug Discovery (http://www.nature.com/nrd/index.html)
Medicinal Research Reviews (http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291098-1128)

Chronological program

First quarter	Classroom activity (number of hours)				Non-contact activity (number of hours)		
	Theory	Practical classroom	Student meeting	Test	Student individual work	Practical class preparation	Group work
Week 1	2				4		
Week 2	3				4		
Week 3	3				4		
Week 4	2				4		2
Week 5	3				4		1
Week 6	3				4		2
Week 7	3				4		1
Week 8	2				4		2
Week 9	2		1		4		1
Week 10	1	15	1	1	4	7	2
Week 11	2		1		4	8	1
Week 12	1		1		4		2
Week 13	2		1		4		1
Week 14	1		1		4		
Week 15	3				4		
Week 16	3						
Total number of hours	36	15	6	3	60	15	15

Evaluation

1. These include tests (November 25th, 2016; January 26th, 2017; July 12th, 2017), individual/group meetings and practical classes.
2. The student can benefit from a one-time assessment; this must be formally applied during the first 15 days of the course 2016 2017.
3. Individual assessments obtained during previous courses will not be considered the next following courses.