Universitat Autònoma de Barcelona

2019/2020

Bioorganic Chemistry

Code: 102518
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	OT	4	0

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

To attend this course it is necessary to have previously approved the subjects: "Estructura i reactivitat dels compostos orànics" "Mètodes de sintesi" i Laboratori de síntesi"

Objectives and Contextualisation

The general objective of the subject "Bioorganic Chemistry" is to provide the students with a general overview of natural products (structural, biosynthetic and ecological characterictics, and their applications as a source of biological active compounds.

Notions about the structural chemistry and biosynthesis of natural products will be provided as well as their function and utility as drugs or other interesting biological activities.

The training objectives of the subject can be summerized in:

1- To understand and know the structures of the importsnt natural products of the secondary metabolism and their biosynthesis

2- To know the biological and pharmacological activities of the most relevant natural secundary metabolites

3- To undertand the ecological and general importance of natural products

4. To be able to propose biosynthestic routes for secundary metabolites

Competences

- "Interpret data obtained by means of experimental measures, including the use of IT tools; identify their meaning and relate the data with appropriate chemistry, physics or biology theories."
- Adapt to new situations.
- Apply knowledge of chemistry to problem solving of a quantitative or qualitative nature in familiar and professional fields.
- Communicate orally and in writing in ones own language.
- Evaluate the health risks and environmental and socioeconomic impact associated to chemical substances and the chemistry industry.

- Handle chemical products safely.
- Handle standard instruments and material in analytic and synthetic chemical laboratories.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Manage, analyse and synthesise information.
- Obtain information, including by digital means.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Resolve problems and make decisions.
- Show an understanding of the basic concepts, principles, theories and facts of the different areas of chemistry.
- Show initiative and an enterprising spirit.
- Show sensitivity for environmental issues.
- Use IT to treat and present information.
- Use the English language properly in the field of chemistry.
- Work in a team and show concern for interpersonal relations at work.

Learning Outcomes

1. Adapt to new situations.
2. Carry out basic synthesis, separation and purification procedures in an organic chemistry laboratory.
3. Classify natural products in accordance with their biosynthesis.
4. Communicate orally and in writing in ones own language.
5. Critically analyse synthetic pathways described in the bibliography.
6. Describe and identify the main groups of natural products and the distinctive characteristics of each.
7. Describe the processes and reactions that occur in biological systems.
8. Describe the structures of the natural products of secondary metabolism.
9. Describe the synthesis of natural products in living beings.
10. Describe useful reactions in organic synthesis.
11. Design reasonable biosynthetic pathways for natural products.
12. Handle English language terms in relation to the synthesis of organic and bioorganic compounds.
13. Identify the ecologic and pharmacologic importance of natural products.
14. Identify the importance of natural products as a source of biologically active compounds.
15. Identify the main structural traits of biomolecules in order to analyse or modify them.
16. Identify the most relevant documentary sources on organic chemistry.
17. Identify the risks involved in the handling of chemical compounds used in biological chemistry, and apply suitable protocols for the storage or elimination of the waste generated.
18. Justify the results obtained in the laboratory for synthesis, separation, purification and characterisation processes of organic and bioorganic compounds on the basis of knowledge about their structure and properties.
19. Learn autonomously.
20. Manage the organisation and planning of tasks.
21. Manage, analyse and synthesise information.
22. Obtain information, including by digital means.
23. Perform synthesis of organic and bioorganic compounds using protocols written in the English language.
24. Properly handle glass and other common materials in an organic chemistry laboratory.
25. Properly interpret data obtained in the laboratory after computerised treatment and on the basis of the acquired knowledge.
26. Propose creative ideas and solutions.
27. Reason in a critical manner
28. Recognise strategies for the design of organic syntheses.
29. Recognise the common chemical compounds found in the laboratory that require special safety measures.
30. Recognise the three-dimensional view of molecules and organic reactions.
31. Resolve problems and make decisions.
32. Safely manipulate chemical reagents and organic compounds.

33. Show initiative and an enterprising spirit.
34. Show sensitivity for environmental issues.
35. Use IT to treat and present information.
36. Use basic instruments to characterise organic chemical compounds.
37. Use spectroscopic techniques for the structural elucidation of organic and bioorganic compounds.
38. Work experimentally with biological material (inert, aseptic and/or controlled atmospheres).
39. Work in a team and show concern for interpersonal relations at work.

Content

PROGRAM

Biosynthetic routes

Primary and secondary metabolism. Main biosynthetic routes: shikimate, acetate, mevalonate. Methods used in the determination of biogenetic sequences.

Semiochemicals

Ecological chemistry. Classification of semiochemicals. Interactions plant-insect. Allelopathy. Phytoalexines. Pheromones

Fatty acids and poliketides

The acetate hypothesis. Saturated fatty acids. Unsaturated fatty acids. Aromatic poliketides. Macrolides.

Shikimic acid derivatives

Phenolic compounds. Aromatic amino acids (tryptophan, phenylalanine, tyrosine) and derivatives. Transamination and NIH shift. Cinamic acids and derivatives. Pharmacological applications: L-DOPA, salicine as a model of Aspirin. Lignanes and lignines. Flavonoids.

Terpenoids

Structural classification. Acetate-mevalonate pathway. Monoterpenes. Sesquiterpenes. Diterpenes. Steroids. Cholesterol.

Secondary metabolism amino acids

Prebiotic amino acid formation. Antibiotic b-lactamics. Penicillins and cephalosporines.

Alkaloids I

Alkaloids derived from ornithine, lysine and nicotinic acid.

Alkaloids II

Benzylisoquinoline type alkaloids. Opium alkaloids (thebaine, morphine, codeine), physiological effects and biosynthesis. The Curare and the strychnine. Quinine: the base remedy against malaria.

Methodology

In accordance with the objectives of the subject, the student will have to be involved in a series of activities to achieve the stablished knowledge and skills. These activities can be grouped into three different types:

Master class: During these classes the teacher will transmit the basic knowledge of the subject; knowledge that will be complemented with the individual work of the student consulting the bibliography that the professor will

indicate. The master classes are conceived as a fundamental unidirectional method of transfering the teacher's knowledge to the student. During the classes student``'s participation will be encouradged through the dynamization of classes by the resolution of cases and qusetions in a regular way.

Problem classes: A dossier of exercises will be given. These exercises will be solve during the course. A selected part of these exercices will be solved by the problem's teacher so thet the students can learn the appropiate methodology to find the solutios. In these sessions, the solutions proposed by the students will be discussed, based on the autonomous work developed. During this process, student's participation will be important. Teacher will help to develop the critical sense and logical reasoning, in order to increase the ability of the students to solve problems.

Practical Classes:There will be laboratory sessions (4 sessions of 4 hours each) related to natural products, through which the students will also practice laboratory techniques referring to the manipulation of chemicals as well as the use of small equipment and instrumental techniques. The work will be supervised by a teacher that will evaluate the students considering their attention and performance in the laboratory as well as the reports and laboratory notebook. If an student is involved in an incident that may have serious consequences of security, he can be expelled from the laboratory and in consequently he will suspend the subject.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Practical classes	16	0.64	1, 4, 23, 2, 20, 17, 25, 18, 24, 32, 34, 29, 31, 39, 38, 36, 37
Theoretical classes	35	1.4	19, 3, 4, 9, 7, 6, 8, 11, 20, 21, 14, 13, 16, 15, 22, 31
Type: Supervised			
Tutorials	5	0.2	9, 11, 21, 25, 26, 27, 31
Type: Autonomous			
Learning anr problems resolution	87.2	3.49	5, 3, 4, 9, 7, 6, 8, 10, 11, 21, 14, 13, 16, 15, 22, 30, 28, 35

Assessment

The competences of this subject will be evaluated through two modules, which include the Written Tests Module and the Laboratory Module, which will be assigned a specific weight in the final grade.

It is necessary to obtain a minimum grade of 5 points in the global evaluation to pass de subject.

The non-presented: A student receives the grade of non presented if he did not attend any written test and if he did not attend any of the laboratory practices

1. Written Test Module:

It will consist of two compulsory partial exams. To pass by partials, you must have a minimum grade of 5.0 points in each, and the final grade will be the simple average of the marks of the two partials. For students who do not pass one of the partials or both of them, there will be a repesca test (written final examination). In this case the grade will be the weighted average of the written final test (90%) and of the marks obtained in the two partial tsest (remaning 10%). It is necesarry to obtain a minmum of 5 in the grade of the final test to pass the subject.

These exams will consist mainly of practical exercices to solve and some sdhort theoretical questions

First partial exam: Will colect approximately 40% of the subject matter.

Second partal exam: The second written test will be carried out after finishing the theoretical classes and may include some of the conceps that have been already evaluated in the first partial exam as well as in the practical calsses.

Repesca test: It will be done after the two partials and will include all the course material. To participate the students must have been previously evalutade in the partial exams

2. Laboratory Module:

The practices are obligatory. Reports will be delivered and the skills of the student will be assesed

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory Module	15%	1.1	0.04	1, 19, 33, 23, 2, 20, 21, 17, 25, 18, 12, 24, 32, 34, 22, 26, 27, 29, 39, 38, 36, 35, 37
Written Test Module	85%	5.7	0.23	5, 3, 4, 9, 7, 6, 8, 10, 11, 14, 13, 16, 15, 27, 30, 28, 31

Bibliography

Medicinal natural Products. A biosynthetic approach. P. M. Dewick, John Wiley and Sons, 2002. Find Electronic Version in the Library UAB

Natural products: their chemistry and biological significance. J. Mann, R. S. Davidson; J. B. Hbbs, D. V. Banthorphe and J. B. Harbone. Pearson Education Limited, 1994