Universitat Autònoma de Barcelona

2018/2019

Biomoleculary Chemistry

Code: 42427
ECTS Credits: 6

Degree	Type	Year	Semester
4313385 Industrial Chemistry and Introduction to Chemical Research	OT	0	1

Contact

Name: Maria Isabel Pividori Gurgo

Email: Isabel.Pividori@uab.cat

Use of languages

Principal working language: english (eng)

Teachers

Ramón Alibés Arqués

Joan Suades Ortuño

Manel del Valle Zafra

Adelina Vallribera Massó

Jean-Didier Pierre Marechal

Oscar Palacios Bonilla

Prerequisites

The students involved in this module should have background in chemistry (Analytical Chemistry, Physical Chemistry, Inorganic Chemistry and Organic Chemistry), as well as knowledge in Mathematics, Physics and Biology. Students should also have skills in management of common office applications, possess the English knowledge necessary for understanding lectures, scientific texts, documents, seminars and conferences. Graduates in Chemistry, Chemical Engineering, Materials Science, Nanoscience, Environmental Sciences, Biotechnology, Biochemistry have enough background to take part of this module.
Advanced level of English (level B1) of the Common European Framework Reference for Languages of the European Council is required.

Objectives and Contextualisation

The role of bioanalytical, bioorganic and bioinorganic chemistry in genomics, proteomics, metabolomics and medicine.

- Applying basic concepts of chemistry in biological systems in the field of human health, environmental control, food safety and biotechnology industry.
- Integrating bio recognition and biological reactions in chemical methodology.
- Handling the most common techniques in chemistry to analyze, separate, identify and synthesize compounds in a biological context.
- Applying this knowledge to solve daily problems.

Skills

- Apply materials and biomolecules to innovative fields of chemical industry and research.
- Correctly apply new information capture and organisation technologies to solve problems in professional activity.
- Identify information in the scientific literature using the appropriate channels and integrating said information to approach and contextualise a research issue.
- Innovate in chemical synthesis and analysis methods related with different areas of Chemistry.
- Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
- Propose alternatives for the solving of complex chemical problems in different chemical specialities.
- Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
- Students should know how to apply the knowledge acquired and the capacity to solve problems in new or little-known areas within broader (or multidisciplinary) contexts realted to thier area of study
- Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
- Use scientific terminology in the English language to defend experimental results in the context of the chemistry profession.

Learning outcomes

1. Applying general methods of analysis and characterization of biomolecules.
2. Correctly apply new information capture and organisation technologies to solve problems in professional activity.
3. Design synthesis strategies and recognize the properties of natural products.
4. Differentiate ligand-receptor interactions and relate specific biorecognition processes.
5. Identify information in the scientific literature using the appropriate channels and integrating said information to approach and contextualise a research issue.
6. Identify the contribution of Bimolecular Chemistry to medical and biomedical applications.
7. Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
8. Recognize the structure of biomolecules and mimetic and relate it to their biological function
9. Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
10. Students should know how to apply the knowledge acquired and the capacity to solve problems in new or little-known areas within broader (or multidisciplinary) contexts realted to thier area of study
11. Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
12. Use modified biomolecules in bio-analysis.
13. Use scientific terminology in the English language to defend experimental results in the context of the chemistry profession.

Content

Topics:

- Structure, function and biorecognition of natural and recombinant biomolecules such as enzymes, antibodies, DNA, cellular receptors, DNA/RNA, metal-containing biomolecules. Biomimetics.
- Molecules for medical diagnosis and therapy
- Structure and function of medicinal natural products. Groundwork in natural product chemistry and phytochemistry.
- Computational Techniques in Biomolecular Chemistry. Relationship between chemical, biological and conformational space.
- Biomolecule production. Monoclonal and polyclonal antibodies. Recombinant proteins. Separation of biomolecules and labelling with nanotags. Bioanalysis. Immunoassays, PCR, biological catalysed methods.
- Integration of nanomaterials in rapid diagnostic test (lateral flow, biosensors, agglutination test, immunoassays) for diagnostics of emerging infection diseases.

Biomolecules & Biomimetics. Structure, function and biorecognition

Contents: Proteins: enzymes, affinity proteins, antibodies, diabodies, affibodies, avimers, cellular receptors. Biorecognition and function: enzyme/substrate; antigen/antibody; receptor/ligand interaction. Cell signaling. DNA/RNA structure and function. Amplification. Molecular beacons. Aptamers.Molecular imprinted polymers and plastic antibodies.

Metal-containing biomolecules: structure, function, and mimetics.

Content: The biochemistry of metal ions. Uptake, transport and storage of metal ions in biology. Electron transfer, respiration, and photosynthesis. Oxygen metabolism. Other metaloproteins of interest. Metal ion receptors and signaling. Metals in medicine.

Computational Techniques in Biomolecular Chemistry

Content: Specificities of computation at the interface chemistry-biology. Relationship between chemical, biological and conformational space. Protein-ligand dockings. Molecular Dynamics. Multiscale. Advantages, limitations. Reactivity in biochemical systems. Examples.

Chemistry and biomedicine: molecules for medical diagnosis and imaging

Content: General aspects of imaging techniques. SPECT radiopharmaceuticals based on Tc-99m (nuclear and chemical properties, kit reactions and some examples of relevant technetium radiopharmaceuticals). Other SPECT radiopharmaceuticals. PET radiopharmaceuticals, 18F-Fluorodeoxyglucose and C-11 radiotracers. Therapeutic radiopharmaceuticals. Magnetic resonance imaging contrast agents.

Natural products: biosynthesis and properties

Content: Natural products in drug discovery and therapeutic medicine: historical overview. Carbohydrates, the sweet molecules of life. The acetate pathway: fatty acids and polyketides. The mevalonate pathway: terpenoids and steroids. The shikimate pathway: aromatic aminoacids and phenyl propanoids. Alkaloids, secrets of life.

Biomolecule production, separation, modificationand determination

Contents: Isolation and production of biomolecules. The immune system: production of polyclonal and monoclonal antibodies. Separation strategies. Labelling with nanotags and immobilization of biomolecules on nanostructured materials. Bioanalysis: immunochemical methods, DNA assays, PCR, biological catalysed methods, other biological catalysts: DNAzymes, biosensing. Chips and arrays.

Nanomaterials in biosciences

Contents: Biorecognition with biologically-modified quantum dots, carbon nanotubes, metal and magnetic nanoparticle: medical diagnosis, nanomedicine and bioanalysis.

Methodology

Lectures
Problem-solving lectures
Cooperative activities
Seminars
Preparation and oral presentation of papers
Tutorials

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Lectures	30	1.2	6, 7, 12
Problems	8	0.32	2, 10, 13
Type: Supervised			
Tutorials	5	0.2	5, 10, 11
Type: Autonomous			
Autonomous learning and studying	49	1.96	5, 9
Preparation of oral presentation and papers	40	1.6	2, 5, 10, 9, 13

Evaluation

The evaluation of this module will take into account the attendance and participation in class as well as the work and assessments presented by the students. All subjects are compulsory attendance. The different topics presented by each of the professors will be separately evaluated, by different assesments including writing exams, theoretical and practical tests, oral presentations, research papers discussion, in-class brief questions, written works, etc.

- Every professor decides the number and typology of evaluation activities: oral presentations, written exams, delivery of discussed articles and small written tests….

- The final mark of the module will be the sum of the mark of every professor multiplied by the percentage of his classes in the total teaching of the module.

- The marks of the written exams must be above 3.5 in order to average with other marks of the professor and/or the module.

- There will be a period in January to repeat written exams with marks under 5. Only students that had attended to 2/3 of the evaluation activities will be able to retake these exams in January. In the case of exams under 3.5 will be mandatory to the student, in case of exams between 4 and 5 would be optional to the student.

- In the case that a student will not arrive to a 3.5 mark after the retaking exam in January, the coordinator of the module could proceed to average this mark with the rest of the module. However, this option can only be considered for two written exams in the whole master.

- The marks of other evaluations activities (i. e. oral presentations) will average with the rest of the marks of the professor/module independently of the value. There will not be option of repeating these other evaluation activities.

- An average mark of 5.0 is mandatory in order to pass a module.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Oral defense of projects	40 %	6	0.24	3, 5, 11, 13
Reports and problems	30 %	4	0.16	2, 5, 6, 7, 12

Writing assessment	30 %	8	0.32	1, 4, 5, 6, 10, 9, 8, 12

Bibliography

Medicinal natural products. A biosynthetic approach, P.M. Dewick, Jonh Wiley & Sons, 2002

Química Bioinorgánica**,** J. S. Casas, V. Moreno, A. Sánchez, J. L. Sánchez, J. Sordo, Editorial Síntesis, Colección Biblioteca de Químicas, 2002

Bioanalytical Chemistry, S. Mikkelsen, E. Corton, Wiley, 2004

Molecular Modelling Principles and Applications - Second Edition -Andrew R. Leach - Ed: Prentice Hall 2001

Addicional Bibliography

Natural Products: their chemistry and biological significance, J. Mann, R.S. Davidson, J. B. Hobbs, D.V. Banthorpe, J. B. Harborne Prentice Hall, 1994

Natural Products Chemistry: A mechanistic and biosynthetic approach to secondary metabolism, K.B.G. Torsell, John Wiley & Sons, 1983

Inorganic Chemistry in Biology,P. C. Wilkins, R. G. Wilkins, Oxford Chemistry Primers, n. 46, Oxford University Press, 1997

Principles of Bioinorganic Chemistry, S. J. Lippard, J.M. Berg, University Science Books, 1994

Principles and Practice of Bioanalysis, R. F.Venn, (Editor), Taylor & Francis, 2000.

Bioanalytical Chemistry, A. Manz, N. Pamme, D. Iossifidis, Imperial College Press, 2004.

Principles of Chemical and Biological Sensors, D. Diamond (Editor), Wiley, 1998.
Biosensors, Elizabeth A.H. Hall, Open Univ Press, 1991