Biomoleculary Chemistry

Code: 42427
ECTS Credits: 6

2025/2026

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

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

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.

Competences

- 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

General content

• Structure, function and biorecognition of natural and recombinant biomolecules such as enzymes, antibodies, DNA, cell receptors, DNA/RNA, metal-containing biomolecules. Biomimetic.

• Molecules for medical diagnosis and therapy .

• Computational techniques in Biomolecular Chemistry. Relationship between chemical, biological and conformational space.

• Proteomics

• Production of biomolecules. Monoclonal and polyclonal antibodies. Recombinant proteins. Separation of biomolecules and labelling with nanomaterials. Bioanalysis. Immunoassays, PCR, catalytic biological methods.

• Biosensors, nanobiosensors and advanced sensing technologies. Integration of nanomaterials in rapid diagnostic tests (lateral flow, agglutination test, immunoassays, Lab-on-a-chip) for the diagnosis and monitoring of diseases.

Syllabus

Biomolecules and biomimetics. Structure, function and biorecognition. Contents: Proteins: enzymes, affinity proteins, antibodies, diabodies, affibodies, avimers, cell receptors. Biorecognition and function: enzyme/substrate; antigen/antibody; receptor/ligand interaction. Structure and function of DNA/RNA. Amplification. Molecular beacons. Aptamers. Molecularly imprinted polymers and plastic antibodies.

Biomolecules containing metals: structure, function and mimetics. Content: The biochemistry of metal ions. Capture, transport and storage of metal ions in biology. Electron transfer, respiration, and photosynthesis. Oxygen metabolism. Other metalloproteins of interest. Metal ion receivers and signaling. Metals in medicine.

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

Proteomics: Contents: Principles of proteomics, types and preparation of samples, peptide separation techniques, mass spectrometry analyzers and ionization sources, bioinformatic analysis, examples of applications of proteomics protocols in biomedicine.

Biosensors and Biomolecular Chemistry. Contents: Definition, historical development and evolution. Components. Types of bioreceptors and transducers. Market trends and challenges, key sectors. Case studies of successful biosensors. Types of specialized biosensors.

Production, separation, modification and determination of biomolecules. Content: Isolation and production of biomolecules. The immune system: production of polyclonal and monoclonal antibodies. Separation strategies. Labelling with nanomaterials and immobilization of biomolecules in nanostructured materials. Bioanalysis: immunochemical methods, DNA analysis, PCR, biological catalytic methods, other biological catalysts: DNAzymes, biodetection. Chips and arrays.

Nanobiosensors and advanced sensing technologies : Role of nanomaterials in molecular recognition, nanostructured transducers (metal nanoparticles, carbon dots, quantum dots, carbon nanotubes, graphene). Biofunctionalization of surfaces and improvement of signals. Advanced biosensor technologies: nanomaterials and lab-on-a-chip, wearable and implantable biosensors. Artificial intelligence (AI) and data analytics in biosensing. Biosensors for personalized medicine.

Activities and Methodology

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

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

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment 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

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, tests.

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

- To pass a module, it is mandatory to have a mark of 3.5 or higher in 75% of all the activities 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. In the case of exams under 3,5, it will be mandatory to the student. In the case of exams between 3,5 and 5 it would be optional.

- 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 be not option of repeating these evaluation activities.

VERY IMPORTANT: Partial or total plagiarising will immediately result in a FAIL (0) for the plagiarised exercise and the WHOLE subject. PLAGIARISING consists of copying text from unacknowledged sources -whether this is part of a sentence or a whole text - with the intention of passing it off as the student's own production. It includes cutting and pasting from internet sources, presented unmodified in the student's own text. Plagiarising is a SERIOUS OFFENCE. Students must respect authors' intellectual property, always identifying the sources they may use; they must also be responsible for the originality and authenticity of their own texts.

In the event of a student committing any irregularity that may lead to a significant variation in the grade awarded to an assessment activity, the student will be given a zero for this activity, regardless of any disciplinary process that may take place. In the event of several irregularities in assessment activities of the same subject, the student will be given a zero as the final grade for this subject.

Bibliography

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

Bibliografia addicional

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

Software

ChemDraw

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(TEm) Theory (master)	1	English	first semester	morning-mixed