Universitat Autònoma de Barcelona

2020/2021

Protein Chemistry and Engineering

Code: 104063
ECTS Credits: 6

Degree	Type	Year	Semester
2501922 Nanoscience and Nanotechnology	OT	4	0

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

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

Teachers

David Reverter Cendrós

Prerequisites

There are no previous formal requirements, but it is assumed that the student acquired beforehand solid knowledge on the subjects of the three first courses, particularly on the subjects of the 1st course on the basis of Biochemistry, Chemical reactivity and Cell biology, of the 2nd course on Molecular biology and Organic Chemistry, and on the 3rd course on Molecular spectroscopy and Analytical chemistry.

As in other subjects, most of the bibliography is in english, language that is also used in an important way in the presentations displayed at the classes and other activities. The use of this language by the students in the supervised activities (Problems and Practical classes, Seminars ....etc), will be positively evaluated.

Objectives and Contextualisation

General goals. This subject will deal with the structural and functional characteristics as well as with the reactivity/interaction of amino acids, peptides and proteins. Also, on how they have evolved biologically and how they can be transformed by rational redesign, directed evolution or chemo-biological modifications at the laboratory in order they adopt structures, superstructures and properties of fundamental and applied interest. Proteins are structural molecules, regulatory and effectors in most biochemical and biological processes, natural/ pathological/ of industrial interest, as well as frequent protagonists, and among the most diverse among them. The knowledge on their properties and strategies to transform them is fundamental for the deep understanding of a significant number of subjects within the degree of Nanoscience and Nanotechnology.

Specific goals.

- Get a deep knowledge of the physico-chemical characteristics of amino acids, peptides and proteins, as well as of their reactivity and modifications.
- Describe and apply the methodologies for the analysis of the sequence of proteins and the synthesis of peptides.

- Recognize the structural elements, the different levels of complexity, the types of folding for proteins and their capability in the formation of higher order structures..
- To know how to consult and get access to the information sources to analyze and classify proteins structurally.
- To know and be able to describe and apply the most used methods for the analysis of the conformation and stability of proteins, including the three-dimensional analysis.
- Describe the molecular basis of the folding of proteins, of its molecular dynamics, post-translational modification, intra- and extra- cellular transit.
- To know how to establish the evolutionary relationships among proteins, and knowthe methods for the structural analysis and prediction.
- Understand and know how to apply the most usual methodologies for the production and purification of recombinant proteins.
- To know how to select the best strategies for the modification and optimization of the properties of peptides and proteins. Understand the basis for its design, for the construction of mini-, super-structures and mimetics, and the methodologies used in such processes. Also, to know about approaches that have been valid to form nanostructures and nanoprobes with them.
- Get an overall view of the structure-function relationships in proteins, and about the applications of such biomolecules in medicine, industry and research.
- Integrate the acquired theoretical knowledge to interpret the results of scientific experiments and to solve experimental problems, using the proper scientific terminology.

Competences

- Adapt to new situations.
- Apply the concepts, principles, theories and fundamental facts of nanoscience and nanotechnology to solve problems of a quantitative or qualitative nature in the field of nanoscience and nanotechnology.
- Communicate orally and in writing in ones own language.
- Demonstrate knowledge of the concepts, principles, theories and fundamental facts related with nanoscience and nanotechnology.
- Interpret the data obtained by means of experimental measures, including the use of computer tools, identify and understand their meanings in relation to appropriate chemical, physical or biological theories.
- Learn autonomously.
- Manage the organisation and planning of tasks.
- Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
- Propose creative ideas and solutions.
- Reason in a critical manner
- Recognise and analyse physical, chemical and biological problems in the field of nanoscience and nanotechnology and propose answers or suitable studies for their resolution, including when necessary the use of bibliographic sources.
- Recognise the terms used in the fields of physics, chemistry, biology, nanoscience and nanotechnology in the English language and use English effectively in writing and orally in all areas of work.
- Resolve problems and make decisions.
- Show motivation for quality.
- Work correctly with the formulas, chemical equations and magnitudes used in chemistry.
- Work on the synthesis, characterisation and study of the properties of materials on a nanoscale from previously established procedures.

Learning Outcomes

1. Adapt to new situations.
2. Communicate orally and in writing in ones own language.
3. Correctly use the necessary computer tools to interpret and expose the results obtained.
4. Explain the physical and chemical properties that enable different levels of protein folding, and that determine their dynamic and functional properties.

5. Extract three-dimensional structures of proteins and nucleic acids from databases to understand their properties
6. Identify the techniques and applications of protein engineering.
7. Interpret experimental data on stability, folding and aggregation of proteins.
8. Interpret the results obtained from genetic and protein engineering techniques.
9. Learn autonomously.
10. Manage the organisation and planning of tasks.
11. Obtain, manage, analyse, synthesise and present information, including the use of digital and computerised media.
12. Perform basic genetic engineering and protein engineering procedures.
13. Perform separation, purification and analysis procedures in several metabolites, proteins and nucleic acids.
14. Propose creative ideas and solutions.
15. Reason in a critical manner
16. Recognise the English terms employed in biochemistry, molecular biology, microbiology, immunology and in subjects related with nanoscience and nanotechnology.
17. Resolve problems and make decisions.
18. Show motivation for quality.
19. Understand texts and bibliographies in English on biochemistry, molecular biology, microbiology, immunology and in subjects related with nanoscience and nanotechnology.
20. Work correctly with the formulas, chemical equations and magnitudes used in chemistry.

Content

List of topics of theory proposed for the subject PROTEIN CHEMISTRY AND ENGINEERING

I. Fundamental properties of amino acids and proteins

II. The peptide bond and the polypeptidic sequence

III. Structural determinants. Secondary structures

IV. Structural classification of proteins

V. Structure-function correlations in proteins. Examples

VI. Protein quaternary structure

VII. Determination of the three-dimensional structure of proteins

VIII. Protein folding and conformational dynamics

IX. Post-translational processes and modifications

X. Protein engineering: heterologous production

XI. Protein engineering: redesign and *de novo* synthesis

Methodology

The training activities are divided into two sections: theory classes and problem classes and / or seminars, each one with its specific methodology. These activities will be complemented by a series of tutoring sessions that will be programmed additionally.

Theory classes The teacher will explain the content of the syllabus with the support of audiovisual material that will be made available to students in the Moddle classroom of the subject. These lectures will be the most important part of the theory section.

Problem Classes and / or Seminars A set of statements of subject problems (related to the topics developed in Theory) will be made available to students and will be accumulated in the form of a dossier on the Virtual Campus, which will be resolved throughoutthe sessions. Students will work out problems outside class hours individually. Non-expositive classroom sessions will be devoted to the resolution of previously worked problems during the previous week. Complementary or alternatively, seminars may be organized to provide students with this type of teaching that is more lively and additional to that of theory.

Tutorials Students will be made available. The purpose of these sessions is to resolve doubts, revise concepts with a high conceptual difficulty and carry out debates on the topics of the program. These sessions will not be exhibited nor in them will be advanced matter of the official agenda, but will be sessions of debate and discussion.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Problems	18	0.72	1, 19, 2, 18, 12, 13, 4, 5, 10, 6, 7, 8, 11, 14, 15, 16, 17, 20, 3
Theory classes	34	1.36	9, 19, 2, 4, 6, 7, 11, 14, 15, 16
Type: Supervised			
Tutorials	8	0.32	1, 9, 2, 18, 14, 15, 17
Type: Autonomous			
Problems	22.5	0.9	2, 18, 12, 13, 5, 10, 6, 7, 8, 11, 15, 16, 17, 20, 3
Study in general	61.5	2.46	9, 19, 4, 10, 6, 8, 15, 16, 17

Assessment

Theory.
The main evaluation of this part of the subject will have the format of continuous evaluation with two partial tests (35% each), with another final test that allows to examine the content of each one of the two partial not previously surpassed, or both simultaneously, in case you do not pass any of the partial ones. The objective of the continuous assessment is to encourage the continuous effort of the student along the entire subject, allowing also to become aware of its degree of follow-up and understanding of the subject. Students who have passed the theory and problems partitions with a score greater than 4.0 on 10 points, may choose to obtain the average mark of both partial. Those who have not passed the value of 4.0 of either partial shall be examined on the date signed for the final exam of the subject of the partial or partial question, in this case the qualification of the student, The last partial exam is the one that will be taken to calculate the final grade.

Problems and / or Seminars. The weight of the evaluation of this section will be 30% of the total: 15% of this total will be allocated to individual deliveries, problems-exercises and / or active participation in class, and the other 15% will be for exams Individuals of these activities, which will take place in parallel to the Theory exams.

Global evaluation
The subject will be passed when the sum of the different parts weighted by their specific weight in the subject exceeds 5,0 on 10 points. Students who do not, with just cause, participate in the continuous evaluation, can be evaluated through the final test. To opt for the recovery (final exam) it is necessary to present 2/3 of the activities of the subject.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Problem evaluation	30%	3	0.12	1, 2, 18, 12, 13, 5, 10, 7, 8, 11, 14, 15, 16, 17, 20, 3
Theory evaluation	70%	3	0.12	1, 9, 19, 2, 18, 4, 10, 6, 7, 8, 11, 14, 15, 16, 17

Bibliography

Basic

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Complementary

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