Universitat Autònoma de Barcelona

2022/2023

Biomolecule Structure

Code: 42887
ECTS Credits: 9

Degree	Type	Year	Semester
4313794 Biochemistry, Molecular Biology and Biomedicine	OT	0	1

Contact

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Use of Languages

Principal working language: english (eng)

Teachers

Joan-Ramon Daban
Josep Vendrell Roca
Sandra Villegas Hernández
Ramón Barnadas Rodriguez
Josep Bartomeu Cladera Cerdà
David Reverter Cendros
Alex Peralvarez Marin
Susana Navarro Cantero
Nuria Benseny Cases

External teachers

Fernando Gil
Tassos Papageorgiou
Xavier Fernández-Busquets

Prerequisites

University degree in Biochemistry, Biotechnology, Biology, Biomedical Sciences, Genètica, Microbiology, Chemistry, Informatics, Phisics, Veterinary, Pharmacy or Medicine.

Objectives and Contextualisation

-The main goal of the course is to introduce the different biophysical methods used in Biomedical research. The student will acquire the knowledge to understand of the techniques utilized to study the structure and function of macromolecules (proteins, nucleic acids, sugars, macromolecular complexes), according to the state of the art of this techniques in relation to biomedical applications.

-A major objective is to acquire the basic knowledge to solve three-dimensional structures of proteins and their complexes by X-ray crystallography by means of a sincrotron light source. At the end of the course the student will know the theoretical and practical methods to solve three-dimensional structures of proteins, including protein crystalllization in the laboratory and the resolution of protein structures by means of bioinformatics tools.

- At the end of the course the student will know the basic experimental and thoretical methodology to study the properties of macromolecules.

Competences

- Analyse research results to obtain new biotechnological or biomedical products to be transferred to society.
- Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
- Continue the learning process, to a large extent autonomously.
- Develop critical reasoning within the subject area and in relation to the scientific or business context.
- Identify and propose scientific solutions to problems in molecular-level biological research and show understanding of the biochemical complexity of living beings.
- Identify and use bioinformatic tools to solve problems in biochemistry, molecular biology and biomedicine.
- Integrate contents in biochemistry, molecular biology, biotechnology and biomedicine from a molecular perspective.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.
- Use scientific terminology to account for research results and present these orally and in writing.
- Work individually and in teams in a multidisciplinary context.

Learning Outcomes

1. Analyse research results to obtain new biotechnological or biomedical products to be transferred to society.
2. Apply techniques of structural biology to solve scientific problems in molecular biomedicine .
3. Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
4. Continue the learning process, to a large extent autonomously.
5. Develop critical reasoning within the subject area and in relation to the scientific or business context.
6. Distinguish the different biophysical and biochemical methods in order to apply them to problems related to biomedicine.
7. Identify the properties of biomolecules can be characterised using the biophysical techniques being studied.
8. Interpret and analyse biomolecule structures in structural databases (PDB).
9. Interpret and reconstruct protein structures by computer.
10. Know the most advanced methods for structurally characterising the biological systems under study (e.g. protein crystallography, nuclear magnetic resonance, electron microscope, and X-ray diffraction).
11. Process and analyse experimental data from X-ray diffraction.
12. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
13. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
14. Use and manage bibliography and IT resources related to biochemistry, molecular biology or biomedicine.
15. Use scientific terminology to account for research results and present these orally and in writing.
16. Work individually and in teams in a multidisciplinary context.

Content

- Structural dynamics.

- Circular dichroism (CD)

-Dynamic Light Scattering (DLS) (Theory and practical course)

-Interactomics: Basis for protein interactions, at the binary or massive level.

- Structural analysis by Nuclear Magnetic Ressonance.

- Aplications of syncrotron radiation in Biomedicine.

- Structural characteritzation of peptides and proteins related to degenerative precesses and viral infection.

- Immunotherapy with antibiotic fragment: CD, FTIR and fluorescence techniques application to protein design.

- Study of Intrinsically Disordered Proteins

- Structure, dynamics and topology of DNA. Biomedical aspects.

- Analysis of macromolecules complexes and biomolecule interactions using microscopical techniques

- Introduction and practical course to prepare protein crystals

- Visit to the protein crystallography beamline at the ALBA syncrotron.

- Practical computational course to solve protein structures

Methodology

- The working methodology combines theoretical lectures with autonomous work by the student. There will be computer courses and also an initial cristallography course in the laboratory. The course pretends to be more practical. There will also be a visit at the ALBA synctrotron, particularly at the X-ray diffraction for protein crystallography.

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.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Knowledge of biophysical methods and identification of biomolecules properties	70	2.8	2, 10, 6, 7
Type: Supervised			
X-ray data processing and protein model building with computers	35	1.4	8, 9, 11
Type: Autonomous			
New idea development in research and critical arguing	52	2.08	1, 5, 4, 13
Scientific communication	30	1.2	3, 15

use of acquired knowledge	35	1.4	12, 16, 14

Assessment

- In the final evaluation it will be considered the assistance (which is mandatory), the involvement in the lectures, and a short test held on the last day of the module based on the main topics of the course.

- "Non evaluable" will be considered when the evaluation activities (final test and assistance) will not reach a minimal qualification of 5,0.

Important: If plagiarism is detected in any of the works submitted, the student will fail the whole module.

Final mark = T* 0,50 + Av* 0,3 + PC* 0,2

T (Final exam)

Av (continued evaluation)

PC (contribution in classes)

There will be a retake examination possibility. To be eligible for the retake process, the student should have been previously evaluated in a set of activities equaling at least two thirds of the final score of the course or module. Thus, the student will be graded as "No Avaluable" if the weighthin of all conducted evaluation activities is less than 67% of the final score

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Active student involvement	20	0	0	5, 12, 3, 4, 13, 15
Continued evaluation	30	1.12	0.04	1, 2, 10, 6, 7, 8, 9, 11, 16, 14
Writing of test evaluation	50	1.88	0.07	1, 2, 10, 6, 7, 8, 9, 11, 16, 14

Bibliography

- Each lecturer will provide particular bibliography corresponding to their specific topics.

ebook:

Integrative structural biology with hybrid methods / Haruki Nakamura, Gerard Kleywegt, Stephen K. Burley, John L. Markley, editors. Llibre en línia | 2018

Links:

•Protein Crystallography course. Structural Medicine. Cambridge University, MRC-LMB:

http://www-structmed.cimr.cam.ac.uk/course.html

•Dpt. de Biología Estructural. CSIC, Madrid

http://www.xtal.iqfr.csic.es/Cristalografia/index-en.html

Software

UCSF Chimera; VMD; CCP4 interfase package; Coot; Phenix; Pymol.