Universidad Zaragoza

Academic Year/course: 2024/25

27131 - Biophysics

Syllabus Information

Academic year: 2024/25
Subject: 27131 - Biophysics
Faculty / School: 100 - Facultad de Ciencias
Degree: 446 - Degree in Biotechnology
ECTS: 6.0
Year: 4
Semester: First semester
Subject type: Optional
Module:

1. General information

This subject focuses on the knowledge of the physical and physical-chemical bases of the action of biomolecules as a tool to understand the regulation of metabolic processes, energy transformation processes and bioelectrical phenomena that maintain the vital functions of cells and organisms. Its objective is for the student to know these biophysical bases, particularly those where proteins and lipid membranes are involved, and to visualize biomolecules in the scientific-technological field, together with the methodologies of the discipline, as essential tools to address the challenges faced by modern Biotechnology and Biomedicine.

These approaches and objectives are aligned with the following SDGs of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the subject's learning results provides training and competence to contribute to some extent to their achievement: Goal 3: Health and wellness; Goal 5: Gender equality; Goal 7: Affordable and non-polluting energy; Goal 9: Industry, Innovation and Infrastructure.

2. Learning results

Upon completion of the subject, the student will be able to:

- Describe and understand the basic principles of thermodynamics applied to the interaction between biological molecules and their conformational stability
- Determine why alterations in the conformational stability of biomolecules or in their capacity to establish intermolecular interactions are the cause of multiple human diseases.
- Understand the biophysical principles that govern the stability and function of biological membranes.
- Know the strategies most commonly employed by living organisms during biological energy transformation, and understand the dynamic contributions and quantum effects that accompany these processes.
- Understand the basis of bioelectrical phenomena, particularly in eukaryotic cells, and their regulation .
- Use the knowledge acquired in Molecular Biophysics and Biological Membrane Biophysics to propose the design of biotechnological and biomedical systems based on these processes.
- Identify the basic tools of biophysical methods and their applications, and use them to quantitatively determine physicochemical parameters of biomolecules and the biological processes in which they are involved.

3. Syllabus

MASTER CLASSES

Molecular Biophysics

Topic 1. Principles of thermodynamics applied to biological systems.

Topic 2. Conformational and association equilibrium. Conformational and strategic diseases mediated by molecular chaperones.

Topic 3. Biochemical equilibria; macromolecular *crowding*, microenvironments, compartmentalization in organelles.

Topic 4. Biophysical methods in the development of diagnostic tools and treatment of diseases.

Bioenergetics and Biophotonics: biotechnological potential

Topic 5. Transport through biological membranes. Membrane potential.

Topic 6. Biological energy transformation.

Topic 7. Kinetics and dynamics in cellular bioenergetics.

Topic 8. Development of biotechnological and biomedical tools.

Bioelectrical Phenomena and Neuroscience

Topic 9. Ionic channels with regulated opening and closing. Nerve impulse transmission.

Topic 10. Neurotransmission across synapses.

Topic 11. Sensory reception.

EXERCISES.

Theoretical questions and numerical exercises interspersed with lectures.

CASE STUDIES

Case 1: Preparation of apomioglobin and determination of the extinction coefficient.

Case 2: Determination of the heme-apomioglobin dissociation constant by means of differential spectroscopy.

Case 3: Preparation of Liposomes.

Case 4: Analysis Cases 1-3.

4. Academic activities

MASTER CLASSES.

Face-to-face. 3 ECTS. Theoretical knowledge.

PROBLEM SOLVING CLASSES.

Face-to-face. 1 ECTS. Application of the knowledge acquired in the resolution of practical cases in the classroom.

Team and/or individual work by the student who has to solve the problems after the theoretical sessions and prior to the problem sessions.

CASE STUDY CLASSES.

Face-to-face and mandatory. 2 ECTS. The student will be instructed on how to design and perform the experiments, and how to treat their data, perform the calculations and interpret the results. The analysis of the results should lead to the production of a summary and its interpretation, within the sessions in the computer classroom.

5. Assessment system

General assessment.

1. Theory exam. Test with multiple choice questions, resolution of short theoretical questions and/or exercises: 20 multiple-choice questions and 3 theoretical-practical questions (40/60% grade). A grade of 5 out of 10is required for each test.

2. Practical Cases. Attendance and completion are mandatory. The student will prepare a report (1-4 pages) on each case (total 2-3 topics). Reports not submitted on time will not be eligible for a grade higher than 5 (out of 10).

3. Problem Solving. Problem class participation will be evaluated and graded from 0 to 1.

4. General. Theory and Practice (case studies + individual project) must be passed with a grade higher than 5 independently.

5. Final Grade: Theory exam=80% and Practical Cases=20%, up to 1 additional point may be added for participation in problem sessions, practices and discussions. To pass the subject it is essential to achieve a 5 out of 10 in the Theory Exam and in the Practical Cases.

Those students who **do NOT attend the** mandatory practical sessions or do NOT submit the reports must take a **GLOBAL TEST** which will consist of the **Theory Exam** on the same date and time as the rest of the students and an **additional test of data analysis in the computer classroom** . Contribution to final grade 50/50%.

6. Sustainable Development Goals

3 - Good Health & Well-Being
5 - Gender Equality
7 - Affordable and Clean Energy