Universidad Zaragoza

Year : 2018/19

66029 - Advanced methods in biophysics

Syllabus Information

Academic Year:	2018/19
Subject:	66029 - Advanced methods in biophysics
Faculty / School:	100 -
Degree:	537 - Master's in Molecular and Cellular Biology
ECTS:	6.0
Year:	1
Semester:	First semester
Subject Type:	Compulsory
Module:	---

General information

Aims of the course

Context and importance of this course in the degree

Recommendations to take this course

Learning goals

Competences

Learning goals

Importance of learning goals

Assessment (1st and 2nd call)

Assessment tasks (description of tasks, marking system and assessment criteria)

Methodology, learning tasks, syllabus and resources

Methodological overview

The learning process designed for this course begins with the learning of theoretical knowledge for students to acquire an applied orientation in the use of different biophysical techniques. The course aims at students being able to choose the most adequate techniques in each particular case. To achieve this objective, lectures and practice sessions are interspersed to optimize the learning process, reducing the time from students' acquisition of theoretical knowledge until its application.

This strategy is adapted to the resolution of practical problems, which is the most practical part of the course, and to make students confront situations they would face in their daily work in a laboratory. Thus, the course has a fundamentally applied orientation, the proposed activities focus on the application of a series of principles to specific real cases, either through the analysis in teams of experimental results provided by the teacher and interpretation from the biological point of view, or the individual preparation of specific cases that require the application of one or more of the explained techniques.

In general, the studied techniques require equipment of high cost that is not available in teaching laboratories. However, the students will be introduced to some equipment from the research laboratories.

Learning tasks

The course includes the following learning tasks:

Lectures (20 hours). Oral presentations by specialized researchers about the most commonly used biophysical techniques, giving practical examples of their applications to solve scientific problems in biology and biotechnology. The necessary material for these lectures will be provided by the professors to the students through the e-learning platform Moodle.

Practice sessions (20 hours). Practical exercises exemplifying the main topics discussed during lectures and exploring the application of the biophysical techniques. This activity is interspersed with lectures. The material will be provided by professors to the student through the e-learning platform Moodle. The problems will be solved and discussed in class. These activities will allow students to acquire the ability to analyze and solve experimental problems related to the learned techniques. The student will be able to design experiments (or applications) by himself, quantify, analyze and critically evaluate the results obtained.

Seminars (20 hours). Analysis of proposed scientific articles, oral presentations and group discussions. The methodology will consist of management of bibliography, individual and/or group work, oral presentation and defense of the chosen case. The work will be performed individually or in groups of 2-3 students. Professors will follow the individual work of students by scheduling tutoring sessions. The work will be presented and defended by each group of students in class. This assignment will train students in the management of bibliography (scientific publications) and relevant information, and the use of databases and networked applications. The students will practice how to interpret results and communicate conclusions to a specialized and general public.

Assignment (2 hours). At the end of the course, students will make a written test to evaluate the acquisition of basic concepts and procedures of the course. The written test will be based on the syllabus.

Syllabus

The course will address the following topics:

A) Lectures (20 hours)

1. Spectroscopic principles
2. Mass spectrometry
3.

UV/visible spectroscopy

4. Circular dichroism (CD) and optical rotatory dispersion
5. Emissions spectroscopy
6. Infrared spectroscopy and Raman spectroscopy
7. Nuclear magnetic resonance (RMN)
8. Electronic paramagnetic resonance
9. Calorimetry
10. X ray diffraction
11. Optical Biosensors based on Surface Plasmon Resonance (SPR). Biaocore
12. Atomic force microscopy (AFM)

B) Practice sessions: problem solving and practical exercises (20 hours)

- Theoretical estimation of protein concentrations and purity
- Theoretical prediction of the UV/Vis spectra components of proteins. pKa estimation of some aminoacids
- Calculation of equilibrium constants. Determination of thermodynamic parameters and stability constants of biological complexes and ligand binding
- Rapid kinetic techniques: laser flash photolysis and stopped-flow.
- Determination of protein activities. Determination of steady-state and pre-steady state kinetic constants.
- Determination of protein redox potentials.
- Characterization of protein folding (NMR, CD). Thermal denaturation profiles. Determination of thermodynamic parameters.
- Protein Secondary, ternary and quaternary protein determination

C) Seminars (20 hours)

Analysis of proposed scientific articles, oral presentations and group discussions.

Course planning and calendar

The course will begin in mid-October according to the academic calendar of the Master's. The first 40 hours of the course will correspond to the lectures and practice sessions.

The offer of seminars will be announced at the beginning of the course and the deadline for seminars selection by students will be at the end of October.

Oral presentations will be from December to January.

The writing test will take place in late January in the place and date indicated by the Faculty of

Science.

Bibliography and recommended resources

Recommended reading and textbooks:

1. Lehninger Principles of Biochemistry (6º Ed.) D.L. Nelson and M.M. Cox. W.H. Freeman and Company, cop. New York. 2013

2. Introduction to protein structure / Carl Branden, John Tooze . - 2nd ed. New York : Garland, cop. 1999

3. Proteins: structures and molecular properties / Thomas E. Creighton . - 2nd ed. New York : W. H. Freeman, cop.1994

4. Spectroscopy for the Biological Sciences. Gordon G. Hammes. Wiley-Interscience. John Wiley & Sons, Inc. New Jersey, 2005.

5. Science at the nanoscale: an introductory textbook. Chin Wee Shong, Sow Chorng Haur, Andrew TS Wee. Pan Stanford Publishing Singapore. 2010.

6. Introduction to Surface Plasmon Resonance. Anna J. Tudos and Richard B.M. Schasfoort. Chapter 1, pag.1-13. Handbook of Surface Plasmon Resonance. Ed. RSC Publishing. 2008