Teaching guide

IDENTIFICATION DETAILS

Degree:	Biotechnology
Scope	Biology and Genetics
Faculty/School:	Experimental Sciences
Course:	PROTEIN CHEMISTRY AND ENGINEERING
Type:	Compulsory
ECTS credits:	3
Year:	3
Code:	2058
Teaching period:	Sixth semester
Subject:	Advanced Biotechnology Training Technologies
Module:	Biotechnology Tools
Teaching type:	Classroom-based
Language:	Spanish
Total number of student study hours:	75

SUBJECT DESCRIPTION

Description of the scientific foundations of the relationship between the structure of proteins and their biological function.

In addition to presenting the scientific foundations of the relationship between the structure of proteins and their biological function, it is also intended to describe both experimental and theoretical tools that allow us to understand the mechanisms by which proteins perform their functions.

GOAL

The objective of the course is to provide students with the basic knowledge to understand the scientific foundations of the relationship between the structure of proteins and their biological function, as well as to learn to use both experimental and theoretical tools that allow them to understand the mechanisms by which proteins perform their functions.

The specific aims of the subject are:

Apply analysis methods to specific cases of peptides and proteins

Analyze the relationship between amino acid sequences and the secondary and tertiary structures of proteins.

Integrate the structure-function relationship of proteins.

Interpret the catalysis mechanisms of various enzymes.

Determine the role of the different residues involved in catalyzed reactions.

PRIOR KNOWLEDGE

Advanced knowledge of Biochemistry and Molecular Biology
Advanced knowledge of Organic Chemistry
Basic knowledge of physical chemistry

COURSE SYLLABUS

A.- Introduction
B.- Protein chemistry.
C.- Three-dimensional structure of proteins
D.- Protein dynamics

E.- Molecular Design of Proteins
A. Introduction
Topic I. Proteins as polymers. New vision of proteins as complex systems.
Theme II. Physico-chemical properties of proteins. Methods of analysis
B. Protein chemistry.
Theme III. The peptide bond formation reaction: molecular strategy, catalytic mechanism.
Theme IV. Fundamentals of the chemical reactivity of proteins. Typical reactions in protein chemistry. Nucleophilic and electrophilic attacks. Michael's addition reaction. Chemical properties of amino acids. Acid-base properties.
Topic V. Amino acid analysis. Protein Sequencing: Edman Reaction. Edman sequencers.
Theme VI. Chemical synthesis of peptides. Protective groups: incorporation and removal. Activation of amino acids. Solid-phase synthesis. Automation. Semisynthetic methods for preparing proteins.
C. Three-dimensional structure of proteins
Theme VII. In bonds that stabilize a defined structure in space: Hydrogen bonds. Van der Wals forces. Hydrophobic interactions.
Theme VIII. Secondary structure: Alpha helix. Alpha propeller. 3-10 propeller. Parallel and antiparallel Beta sheets. Different types of turns
Theme IX. Tertiary structure and its relationship with function: examples of the mechanism of action of some enzymes.
Theme X. Quaternary Structure: Cooperativity
Theme XI. Three-dimensional structure prediction.
D. Protein dynamics
Theme XII. In Vitro protein folding. Physico-chemical characteristics of the denaturation and renaturation process. In vivo protein folding. Molecular carbines. Pathological folding disorders: amyloidosis, spongiform encephalopathies
Theme XIII. Large-scale protein movements and their relationship to function: examples of enzymes Topic XIV. Simulations of molecular mechanics and dynamics. Force fields. Simulation algorithms.
E. Molecular Design of Proteins
Theme XV. Design of proteins that maintain a defined three-dimensional structure. Protein design with the ability to bind heavy metals.

EDUCATION ACTIVITIES

- Participatory expository classes: Master classes on the topics specified in the program.

- Realization of bibliographic works: Group presentations on specific topics of the subject of a work supervised by the teacher framed within the project-based learning methodology. The teacher will provide the basic material and advice to access and use appropriate sources of information.

- Tutoring through which the teacher, at the request of the student and at the established time for this purpose, will answer questions or discuss the questions posed to him by the student, in order to guide him in learning the subject.

DISTRIBUTION OF WORK TIME

TEACHER-LED TRAINING ACTIVITIES	INDIVIDUAL WORK
30 Horas	45 Horas

SKILLS

Basic Skills

Students must have demonstrated knowledge and understanding in an area of study that is founded on general secondary education. Moreover, the area of study is typically at a level that includes certain aspects implying knowledge at the forefront of its field of study, albeit supported by advanced textbooks

Students must be able to apply their knowledge to their work or vocation in a professional manner and possess skills that can typically be demonstrated by coming up with and sustaining arguments and solving problems within their field of study.

Students must have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgments that include reflections on pertinent social, scientific or ethical issues

Students must be able to convey information, ideas, problems and solutions to both an expert and non-expert audience

Students must have developed the learning skills needed to undertake further study with a high degree of independence

To acquire firm theoretical, practical, technological and humanistic training needed to develop professional activity.

To have acquired the ability for analytical, synthetic, reflective, critical, theoretical and practical thought.

To understand the fundamental laws and principles of physics, mathematics, chemistry and biology as the foundation for the mental structure of a biotechnician.

To acquire the skills needed for experimental work: design, preparation, the compilation of results and the obtainment of conclusions, understanding the limitations of an experimental approach.

To acquire the molecular biology and biochemistry knowledge needed to develop biotechnological processes and products.

General Skills

To acquire firm theoretical, practical, technological and humanistic training needed to develop professional activity.

To have acquired the ability for analytical, synthetic, reflective, critical, theoretical and practical thought.

To understand the fundamental laws and principles of physics, mathematics, chemistry and biology as the foundation for the mental structure of a biotechnician.

To acquire the skills needed for experimental work: design, preparation, the compilation of results and the obtainment of conclusions, understanding the limitations of an experimental approach.

To acquire the molecular biology and biochemistry knowledge needed to develop biotechnological processes and products.

Specific skills

Learn and know how to apply the classic techniques of chemical analysis of proteins.

Learn about the set of technologies and experimental strategies used for the mass analysis and quantification of proteins.

Know and understand the structure and function of enzymes and their applications in the biotechnology industry.

Learn about the main methods of chemical modification of biomolecules and the applications of these bioactive molecules in the different fields of biotechnology.

Develop habits of rigorous thinking

Ability to communicate the knowledge acquired orally and in writing.

Know how to work as a team in an effective and coordinated way.

Be able to self-evaluate the knowledge acquired.

LEARNING RESULTS

Describe the fundamentals on which peptide and protein analysis methods are based.

Application of analysis methods to specific cases of peptides and proteins

Analyze the relationship between amino acid sequence and the secondary and tertiary structures of proteins.

Integrate the structure-function relationship of proteins.

Interpret the catalysis mechanisms of various enzymes.

Describe the main methods of chemical modification of biomolecules and their application in biotechnology.

Apply knowledge of protein structure to biotechnology

Integrate knowledge of the primary structure of proteins with the mechanism of different enzymes

LEARNING APPRAISAL SYSTEM

The evaluation system, based on continuous evaluation, distributes the final grade of the subject into several sections, an important part of which is occupied by the evaluation of theoretical classes.
Ordinary evaluation system.
Evaluation of the theoretical content of the subject: 50%
Evaluation of seminars and/or work: carrying out and presenting exercises, case studies, debates, tutorials, etc.: 50%
A minimum score of 4 out of 10 on the theory exam will be required to pass the course. If in the ordinary call the student has met any of these three requirements but not all of them, the grades of those parts that he would have passed will be maintained for the extraordinary call, then having to pass only those that he did not manage to pass in the ordinary call.
Alternative evaluation system:
Evaluation of the theoretical content of the subject: 60%
Evaluation of seminars and/or work: carrying out and presenting exercises, case studies, debates, tutorials, etc.: 40%
Students in second or subsequent enrollment must contact the teacher to request to take advantage of this system
Plagiarism, as well as the use of illegitimate means in evaluation tests, will be sanctioned in accordance with those established in the Evaluation Regulations and the University's Coexistence Regulations

ETHICAL AND RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE

1.- The use of any Artificial Intelligence (AI) system or service shall be determined by the lecturer, and may only be used in the manner and under the conditions indicated by them. In all cases, its use must comply with the following principles:
a) The use of AI systems or services must be accompanied by critical reflection on the part of the student regarding their impact and/or limitations in the development of the assigned task or project.
b) The selection of AI systems or services must be justified, explaining their advantages over other tools or methods of obtaining information. The chosen model and the version of AI used must be described in as much detail as possible.
c) The student must appropriately cite the use of AI systems or services, specifying the parts of the work where they were used and describing the creative process followed. The use of citation formats and usage examples may be consulted on the Library website(https://www.ufv.es/gestion-de-la-informacion_biblioteca/).
d) The results obtained through AI systems or services must always be verified. As the author, the student is responsible for their work and for the legitimacy of the sources used.
2.- In all cases, the use of AI systems or services must always respect the principles of responsible and ethical use upheld by the university, as outlined in the Guide for the Responsible Use of Artificial Intelligence in Studies at UFV. Additionally, the lecturer may request other types of individual commitments from the student when deemed necessary.
3.- Without prejudice to the above, in cases of doubt regarding the ethical and responsible use of any AI system or service, the lecturer may require an oral presentation of any assignment or partial submission. This oral evaluation shall take precedence over any other form of assessment outlined in the Teaching Guide. In this oral defense, the student must demonstrate knowledge of the subject, justify their decisions, and explain the development of their work.

BIBLIOGRAPHY AND OTHER RESOURCES

Basic

David Whitford Proteins: Structure and Function (2005)

Lubert Stryer Biochemistry Lubert Stryer (2007)
(Lubert Stryer Biochemistry Lubert Stryer (2007) , ||Carl Branden and John Tooze Introduction to Protein Structure (1999))

Additional

Meyer B. Jackson Molecular and Cellular Biophysics. Cambridge University Prees (2006)

Michel Daune Molecular Biophysics: Structures in Motion, Oxford University Prees (1999)