FACULTAD DE CIENCIAS

GRADO EN BIOTECNOLOGÍA

2024/25 YEAR

ENZIMOLOGÍA

Course details

Course name: ENZIMOLOGÍA
Code: 638016
Degree/Master: GRADO EN BIOTECNOLOGÍA **Year:** 2
Field: ENZIMOLOGÍA
Character: OBLIGATORIA **Duration:** FIRST TERM
ECTS Credits: 6.0 **Classroom hours:** 60
Face-to-face classroom percentage: 40.0% **Study hours:** 90
Online platform: https://moodle.uco.es/

Coordinating teacher

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Brief description of the contents

Acquire knowledge in the field of Enzymology, current status and advances. Special emphasis will be placed on the biotechnological application of enzymes in the medical, agroforestry, agri-food and industrial sectors. Specifically we will refer to understand and learn the basic principles of the Enzymology as a science, its historical evolution, current state and future direction and challenges. Emphasis will be put on both practical and theoretical aspects. From the study of the enzymes it is pretended to deep into the knowledge of the living organisms, to understand the cell metabolism, how it does work, is integrated and regulated. Also how to exploit its biotechnological potential in the biomedicine, agrifood and analytical fields. Enzymology is a complex discipline whose body of knowledge results from an integration of mathematics, physics, chemistry, and biology, hence giving an integrated view of the biochemistry. The course is organized in lectures, lab experiments and practical sessions in which questions and exercises will be proposed and solved. From the basic principles developed during the lectures the student should be able to prepare a writing manuscript, present, defend and discuss it critically. At the end of the course he/she should be familiarized with the current literature in the field, the employed scientific terminology, to design an experiment on enzymes, to interprete the experimental results and also to know why and how the enzymes can be used in disease diagnosis and treatments, in food quality improvement and for analytical purposes, just as a few examples. It is pretended not only to present a classical view of the discipline but also a modern one, trying to conect it to molecular biology, -omics approaches, and systems biology. It can be done through the attendance of the lectures and the reading of general text books, but, more importantly, of classical historical papers, the Nobel Prize lectures, and the most recent ones appearing in relevant journals such as Nature and Science. The use of the modern informatic and bioinformatic tools, databases and specialized web pages is also included as an important objective.

Prerequisites

Prerequisites established in the study plan

English level B1.

Recommendations

Knowledge in thermodynamics and kinetics of chemical reactions, chemical functional groups, reactivity and types of reactions.
Handling simple algebraic equations, integrals and derivatives. Statistical analysis.
This knowledge is taught in Physics-Chemistry, Organic Chemistry, Mathematics and other subjects of the first year.

Study programme

1. Theory contents

INTRODUCTION. Enzymes as catalysts. History of Enzymology. Enzyme biotechnology. Nomenclature and classification of enzymes.
ENZYME INVESTIGATION. Methods and techniques. Experimental design. Extraction of enzymes. Enzyme activity assays. Enzyme purification and structural and kinetic characterization. Enzyme immovilization. Enzymology in the Molecular Biology and -omics era. In silico analysis, algorithms and databases.
STRUCTURAL ENZYMOLOGY. Simple and conjugated enzyms. Apoenzyme, coenzymes, and prosthetic groups. Structure and enzyme function relationship. Enzyme evolution. Active and ligand centres. The active site.
ENZYME CATALYSIS. The mechanisms of enzyme action.
RIBOZYMES and SYNTHETIC ENZYMES. Catalytic RNA. Abzymes. Sinzymes. Enzyme engineering.
ENZYME KINETICS, MODELS AND LAWS. Single-substrate reactions. Michaelis-Menten theory. Steady-state theory. Determination of kinetic parameters. Kinetic mechanisms and models.
EFFECT OF PHYSICO-CHEMICAL PARAMETERS ON ENZYME ACTIVITY. Effect of pH. Effect of temperature. Effect of ionic strenght. Enzyme activity in hydrophobic solvents.
MODULATORS OF ENZYME ACTIVITY. Enzyme inhibitors. Inactivators. Reversible inhibitors. Pseudoirreversible inhibitors. Suicide substrates. Substrate and product inhibition. Enzyme activators. Metal activation.
REACTIONS INVOLVING TWO O MORE SUBSTRATES. Mechanisms and models. Reaction rate equations.
ENZYME CONTROL AND REGULATION. Enzymes and metabolic control. Conformational mechanisms, allosterism. Covalent modification. Protein synthesis and degradation. Protein complexes.
ENZYME BIOTECHNOLOGY. Enzymes in biomedicine, agrifood, and forestry sectors. Industrial enzymes. Enzymes in analysis.

2. Practical contents

CLASSROOM PRACTICES

Search for information on enzymes. Scientific literature. Portals and databases on enzymes.
How to prepare and write a scientific manuscript. How to present and discuss it.
Exercises on enzyme classification and nomenclature.
Excercises and problems on enzyme kinetics.

LAB PRACTICES

Invertase as a model enzyme.Chemical and enzymatic assays used to determine invertase activity. Inhibition of invertase
Invertase inmovilization in alginate gels. The effect of temperature on the activity of the inmovilized enzyme.
Invertase reactors for the production of sugar inverted syrups from sucrose.
The use of mathematics, statistics, and bioinformatic tools in the treatment of the experimental data. Presentation and discussion of the results.

Bibliography

1. Basic bibliography

NUÑEZ DE CASTRO I. Enzimología. Ediciones Pirámide, Madrid, 2001.
CÁRDENAS J., FERNÁNDEZ E., GALVÁN F., MÁRQUEZ A.J., VEGA J.M. Problemas de Bioquímica. Editorial Alhambra, Madrid, 1988.
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M Kuddus. 2019. Enzymes in Food Biotechnology. Elsevier. http://bly.covenantuniversity.edu.ng/ebooks/10.pdf
Meenakshi Vachher, Aparajita Sen, Rachna Kapila, Arti Nigam. 2021. Microbial therapeutic enzymes: A promising area of biopharmaceuticals. Current Research in Biotechnology 3, 195-208.
de la Fuente M, Lombardero L, Gómez-González A, Solari C, Angulo-Barturen I, Acera A, Vecino E, Astigarraga E, Barreda-Gómez G. Enzyme Therapy: Current Challenges and Future Perspectives. Int J Mol Sci. 2021 Aug 25;22 (17):9181.

2. Complementary bibliography

It will be provided to students throughout the term.

Methodology

General clarifications on the methodology (optional)

The methodology used follows a continuous assessment model.
- **Projects based on the course contents** refer to the lectures given by the teaching staff.
- **Information processing activities** refer to the daily questions and weekly exercises proposed by the teacher and which have to be solved by the student. They also refer to the weekly presentation by

the students of enzymatic articles published in high impact journals (Nature, Science).
- **Oral communication activities** refer to the oral presentation of a topical or interesting subject.
- **Written expression activities** refer to a written work on an enzyme.

In relation to the development and evaluation of the subject, the lecturer may implement special measures in a justified and motivated manner, especially with regard to the evaluation of students, including the possible non-approval of the subject, in cases of exceptional situations such as plagiarism, use of fraudulent methods in assignments or exams, as well as other circumstances that may affect the principle of proportionality, such as repeated absences or any violation of the basic rules of coexistence established in the Coexistence Regulations of the University of Cordoba (approved by the Governing Council on 1 July 2016).

Methodological adaptations for part-time students and students with disabilities and special educational needs

The methodological strategies and evaluation system contemplated in this Guide will be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required. For part-time students it is mandatory to assist to the "Lab practices".

Face-to-face activities

Activity	Large group	Medium group	Total
Information processing activities	5	8	13
Oral communication activities	3	5	8
Practical experimentation activities	-	14	14
Projects based on the course contents	20	-	20
Written expression activities	5	-	5
Total hours:	***33***	***27***	***60***

Off-site activities

Activity	Total
Exercise and problem solving activities	20
Information processing activities	50
Information search activities	20
Total hours	***90***

Results of the training and learning process

Knowledge, competencies and skills

CB2 For students to be able to apply their knowledge to their work or vocation in a professional way, and have skills typically demonstrated through the production

and defence of arguments and the solving of problems within their areas of study.

CB5 Students will have developed the learning skills necessary to undertake subsequent studies with a high degree of autonomy.

CG1 The ability to reason critically and to be self-critical.

CG4 The ability to learn and work independently.

CG7 Know how to use the basic computer tools for communication, information searches, and data processing in one's professional activity.

CG8 Know how to read scientific texts in English.

CE1 Understand the physical and chemical bases of biological processes, including the principles that determine the molecular structure and chemical reactivity of simple molecules.

CE4 Understand the chemical and thermodynamic principles of molecular recognition and biocatalysis, as well as the role of enzymes and other proteins in determining the functioning of cells and organisms.

CE11 Know the principles and applications of the main experimental methods and instrumentation used in Biotechnology, with an emphasis on the techniques for the isolation and characterisation of biological macromolecules, and the assay methods of enzymes, both in vitro and in vivo.

CE15 Know how to apply experimental protocols and work capably in a biotechnological laboratory with biological and chemical material, as regards safety, biotechnological risk assessment; the handling and disposal of biological and chemical waste; and keeping annotated activity logs.

CE17 Possess the mathematical, statistical, and computer skills to obtain, analyse, and interpret data, and to understand simple models of biological systems and processes at the cellular and molecular levels.

CE20 Acquire basic training in the execution of projects, including the ability to carry out a study in the areas of Biochemistry and Molecular Biology, to critically interpret the results obtained, and to evaluate the conclusions reached.

Assessment methods and instruments

Intended learning outcomes	Examination	Group or individual globalizing projects	Means of practical execution	Oral means	Students assignments
CB2	X		X	X	X
CB5	X	X	X	X	X
CE1	X				
CE11	X		X		
CE15			X		
CE17	X	X		X	X
CE20		X	X	X	X

Intended learning outcomes	Examination	Group or individual globalizing projects	Means of practical execution	Oral means	Students assignments
CE4	X	X			
CG1	X	X	X	X	X
CG4		X		X	X
CG7				X	X
CG8		X		X	X
Total (100%)	***25%***	***15%***	***20%***	***15%***	***25%***
Minimum grade (*)	***5***	***5***	***5***	***5***	***5***

(*)Minimum mark (out of 10) needed for the assessment tool to be weighted in the course final mark. In any case, final mark must be 5,0 or higher to pass the course.

General clarifications on instruments for evaluation:

The examinations include class questions (25%).

Under the means of practical execution, laboratory practicals and the submission of the practical report are included (20%).

Oral means include the oral presentation of a topic (15%).

Under the student assignments, the results of the bibliographic research and weekly exercises are included (25%).

Group or individual globalizing projects means the written work on an enzyme (15%).

All the marks obtained in the different assessment instruments will be maintained for all the course examinations. The marks obtained in previous years will be respected.

Clarifications on the methodology for part-time students and students with disabilities and special educational needs:

These students may be evaluated with the same assessment tools as full-time students.

Clarifications on the evaluation of the extraordinary call and extra-ordinary call for completion studies:

The final grade will be: examination: 25%, means of practical execution: 20%, oral means: 15%, students assignments: 25%, and group or individual globalizing projects: 15%.

Qualifying criteria for obtaining honors:

The grade is equal to or higher than 9.0. The number of MH that may be awarded must be in accordance with the conditions indicated in article 80.3 of the Academic Regulations of the UCO.

Sustainable development goals

No poverty
Zero hunger
Good health and well-being
Quality education
Gender equality
Clean water and sanitation
Affordable and clean energy
Decent work and economic growth
Industry, innovation and infrastructure
Reduced inequalities
Sustainable cities and communities
Responsible consumption and production
Climate action
Life below water
Life on land
Peace, justice and strong institutions
Partnerships for the goals

Other Faculty

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