COURSE OUTLINE

1. GENERAL

SCHOOL	APPLIED BIOLOGY AND BIOTECHNOLOGY		
ACADEMIC UNIT	BIOTECHNOLOGY		
LEVEL OF STUDIES	BACHELOR OF SCIENCE		
COURSE CODE	**2905**	**SEMESTER**	8th (Summer)
COURSE TITLE	MOLECULAR ENZYMOLOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	0.12
Practicals (lab work)	2	0.08
Group and/or individual works	1	0.04
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Scientific background/Skills development/General and specialized knowledge
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English)
COURSE WEBSITE (URL)	https://oeclass.aua.gr/eclass/courses/BIOTECH170/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A
Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Are
Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
Guidelines for writing Learning Outcomes

This course aims at acquiring knowledge on:
1) Classification of enzymes and interpretation of their catalytic reactions.
2) Reversible intramolecular forces
3) The formation of enzyme-substrate complex
4) Structural fluctuation and molecular dynamics in enzyme catalysis
5) The basic principles and key mechanisms of enzymatic catalysis.
6) The basic principles of kinetics of enzymatic reactions and the factors affecting the catalytic activity of the enzymes.
7) On the structural features of the enzymes and structure-catalysis relationships.
8) The analysis of kinetic data.
9) The principles of enzyme inhibition and the concepts of allosteric activator or inhibitor.
10) Enzymes that are molecular targets for drug design.

11) Detoxifying enzymes and enzymes that recognize and modify nucleic acids.
12) The principles of enzyme engineering and the modification of the enzyme molecule.
13) The principles of designing structural modifications on the enzyme molecule by applying biocomputing methods and recombinant DNA technology.
14) The principles of designing new forms of enzymes with desired catalytic and structural properties by applying evolutionary methods.
15) The development, through teamwork, of a scientific plan/presentation/essay by exploiting the gained knowledge and multidisciplinary scientific literature.
16) Designing research on molecular enzymology.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology Adapting to new situationsDecision-making Working independently Team work Working in an international environment Working in an interdisciplinary environment Production of new research ideas

Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…

1) Retrieve, analyze and synthesize data and information using contemporary technologies.
2) Make decisions.
3) Work autonomously.
4) Work in teams.
5) Create new research ideas.
6) Advance free, creative and causative thinking.

3. SYLLABUS

Module 1: Principles of enzymology

1) Historical background. Nomenclature and classification of enzymes. Determination of enzyme activity. Enzyme function, active sites, cofactors, specificity
2) Reversible intramolecular forces
3) The formation of enzyme-substrate complex and molecular recognition
4) Structural fluctuation and molecular dynamics in enzyme catalysis
5) The basic principles and key mechanisms of enzymatic catalysis
6) Thermodynamics and structure-catalysis relationships

Module2: Enzyme kinetics

1) The principles of enzyme kinetics and the factors affecting the catalytic activity.
2) Kinetic parameters and reaction equilibrium
3) The analysis of kinetic data, Michaelis-Menten equation and methods of plotting enzyme kinetics data
4) Effect of pH and temperature on enzyme stability and activity.
5) The principles of enzyme inhibition, types of inhibition and the concepts of allosteric activators or inhibitors. Reversible and irreversible inhibition (inactivation). Inhibition constants. Interaction of enzymes and xenobiotic compounds (drugs, insecticides, herbicides, etc.)
6) Multi-substrate enzyme reactions
7) Isotopes in enzyme reaction rate determination
8) Mechanobiology of enzyme systems

Module 3. Enzyme engineering

1) The principles of designing structural modifications using biocomputing methods and recombinant DNA technology
2) Molecular methods for site-directed mutagenesis and random mutagenesis.
3) Principles and methods of *in vitro* directed molecular evolution
4) High-throughput screening methods for enzyme selection
5) *De novo* design of new functional enzymes

6) Chemical modification of enzyme structure
7) Paleoenzymology and reconstruction of ancient enzymes.
8) Hybrid enzymes, semisynthetic enzymes, artificial enzymes, catalytic antibodies and ribozymes
9) Enzyme nanomachines and multi-complex enzymes
10) Applications of engineered enzymes in agriculture, medicine, industry and environmental technologies. Enzymes for molecular biology (structure, mechanism, applications)

Module 4: Enzyme applications
1) Enzymes that recognize and modify nucleic acids
2) Enzymes as molecular targets for drug design
3) Detoxifying enzymes (oxygenases, transferases, hydrolases, etc.)

1. TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Power point presentations. Discipline/subject specific software. Email and internet platform (eclass)
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	<table><tr><th>***Activity***</th><th>***Semester workload***</th></tr><tr><td>Lectures</td><td>39 h (1.56 ECTS)</td></tr><tr><td>Laboratory work</td><td>12 h (0.48 ECTS)</td></tr><tr><td>Group and/or individual works</td><td>13 h (0.52 ECTS)</td></tr><tr><td>Autonomous study</td><td>61 h (2.44 ECTS)</td></tr><tr><td>*Total contact hours and training*</td><td>***125 h (5 ECTS)***</td></tr></table>
STUDENT PERFORMACE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given and if and where are accessible to students.* ,	**I)** Written final examination (60%), based on the lectures offered, containing: - Multiple choice questions - Theoretical knowledge questions - Problems based on lecture material **II)** Laboratory exercises/practical (30%). A written report for every laboratory exercise is required (see below). - The average of the exercise grades counts 30% in the overall score of the course. **III.** Group and/or individual assignments (homework) (10%).

2. ATTACHED BIBLIOGRAPHY

-***Suggested bibliography:***

1) Ιωάννης Κλώνης (2007) Ενζυμολογία, Έμβρυο.
2) Yon-Kahn, Jeannine, Hervé, G. (2010) Molecular and Cellular Enzymology. Springer USA.
3) Hans Bisswanger (2011) Practical Enzymology, 2nd Edition, Wiley-Blackwell.
4) Sheldon J. Park,Jennifer R. Cochran (2010) Protein Engineering and Design. Taylor and Francis

Group.
5) Stefan Lutz, Uwe T. Bornscheuer (2011) Protein Engineering Handbook, Volume 1 & Volume 2, Wiley-VCH Verlag GmbH & Co. KGaA.

-***Suggested scientific journals:***
Biochimica et Biophysica Acta (BBA) - Protein Structure and Molecular Enzymology
FEBS Journal
Enzyme and Microbial technology
Journal of molecular catalysis
Journal of molecular recognition
Biochemical journal
The journal of biological chemistry
Protein Engineering, design and selection