COURSE OUTLINE

1. GENERAL

SCHOOL	APPLIED BIOLOGY AND BIOTECHNOLOGY		
ACADEMIC UNIT	BIOTECHNOLOGY		
LEVEL OF STUDIES	BACHELOR OF SCIENCE		
COURSE CODE	**312**	**SEMESTER**	9ο (Winter)
COURSE TITLE	CIRCULAR BIOTECHNOLOGY – ENZYME BIOREFINERIES		

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	No
COURSE WEBSITE (URL)	

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) The basic distinct units concerning the contribution of enzymes to the production of bio-based products from renewable organic raw materials, as well as their connection with economic & business objectives.

2) Promotion of social awareness, regarding the decisive contribution of circular biotechnology to the manufacturing of products & services of daily use, and to the growth prospects of developing new ones.

3) The methods and techniques used for the discovery of new enzymes for the conversion of renewable organic raw materials.

4) The methods and techniques used for the pre-treatment of plant biomass in order to be further utilized

5) The enzyme systems of microorganisms involved in the degradation of plant biomass.

6) The processes and methods for the biocatalytic production of bioproducts from organic waste
7) The mode of action of individual enzymes on the components of lignocellulose and their synergistic interactions
8) The processes and methods for the development of microbial strains for industrial production of enzymes
9) The basic and special roles of the different classes of enzymes at the level of their application, in order to produce specific products or services.
10) The analysis, evaluation and decision on the case-by-case applicability of techniques and enzymes in order to implement specific projects or products.
11) Collaboration in a team to prepare and present a study that foresees the use or development of enzymes for application in bioprocesses with plant biomass as raw material, applying the above knowledge, using interdisciplinary modern bibliographic data.

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, with the use of necessary technologies.
2) Adapt to new situations.
3) Make decisions.
4) Work autonomously.
5) Work in teams.
6) Create new research ideas.
7) Project planning and management
8) Respect for the natural environment

3. SYLLABUS

1) Basic concepts of Circular Biotechnology – Circular bioeconomy models – Chains of mineral and renewable products and energy – Waste utilization
2) Plant biomass structure – types of polymers and differences among plant species – plants used to produce biofuels and bioproducts
3) Pretreatment of plant biomass – Pretreatment techniques
4) Enzymatic degradation of plant biomass by phytopathogenic and saprophytic microorganisms
5) Cellulose, hemicellulose and lignin degradation enzymes – classes, mechanisms of action and classification
6) Synergism of enzymes in the degradation of lignocellulose
7) Biorefineries – Upgrading plant biomass in terms of polymers (cellulose, hemicellulose, lignin) and monomers
8) Discovery of new enzymes with activity on lignocellulose – Bioinformatics tools

9) Development of microbial strains for the production of industrial enzymes
10) Enzymes and production of biofuels from lignocellulose
11) Enzymes and production of bioproducts from fermentable sugars
12) Biocatalytic production of polymers from renewable raw materials
13) Biocatalytic processes for the production of hydrogen fuel
14) Enzymatic fixation of CO_2 and its use as a raw material for the production of bioproducts

4. 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. Internet platform with practice test. Student contact electronically by 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*	***Activity*** — ***Semester workload*** Lectures — 39 h (1.56 ECTS) Laboratory work — 12 h (0,48 ECTS) Group and/or individual works — 13 h (0.52 ECTS) Autonomous study — 61 h (2,44 ECTS) *Total contact hours and training* — ***125 h (5 ECTS)***
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%).

5. ATTACHED BIBLIOGRAPHY

- ***Suggested bibliography:***

1) P. Christakopoulos, E. Topakas, *Biotechnological production of biofuels*, Greek Academic Libraries Association, 2015
2) K. Buchholz, V. Kasche, U.T. Bornscheuer, *Biocatalysis and Enzyme Technology*, Wiley-VCH Verlag GmbH, Germany, 2005.
3) A. K. Chandel, *Lignocellulose Bioconversion Through White Biotechnology*, John Wiley & Sons Ltd, UK, 2023

- ***Relevant scientific journals****:*

Biocatalysis and Biotransformation
Biotechnology for Biofuels and Bioproducts
Carbohydrate polymers