COURSE OUTLINE

(1) General information

FACULTY/SCHOOL	TECHNOLOGY		
DEPARTMENT	ENVIRONMENTAL SCIENCES		
LEVEL OF STUDY	*Undergraduate*		
COURSE UNIT CODE	NEW **COURSE**	**SEMESTER**	6
COURSE TITLE	ENVIRONMENTAL BIOTECHNOLOGY		

INDEPENDENT TEACHING ACTIVITIES in case credits are awarded for separate components/parts of the course, e.g. in lectures, laboratory exercises, etc. If credits are awarded for the entire course, give the weekly teaching hours and the total credits	**WEEKLY TEACHNG HOURS**	**CREDITS**
THEORETICAL BACKGROUND	3	3
LABORATORY PRACTICE	2	2
TOTAL	5	5

COURSE TYPE Background knowledge, Scientific expertise, General Knowledge, Skills Development	Background Knowledge
PREREQUISITE COURSES:	ENVIRONMENTAL MICROBIOLOGY, BIOLOGY
LANGUAGE OF INSTRUCTION &EXAMINATION/ASSESSMENT:	Greek
THE COURSE IS 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 (certain) level, which students will acquire upon successful completion of the course, are described in detail.
It is necessary to consult:

APPENDIX A

- *Description of the level of learning outcomes for each level of study, in accordance with the European Higher Education Qualifications' Framework.*
- *Descriptive indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and*

APPENDIX B

- *Guidelines for writing Learning Outcomes*

Upon completion of the course the students are expected to

- *Have a understanding of the fundamentals of Environmental Biotechnology and the relevant application fields*
- *Have a understanding of the main biotechnological applications of microbes in environmental practices for the remediation of contaminated environmental matrices*
- *Have a good understanding of the use of microorganisms as biological cell factories for the*

production of novel products with low environmental footprint and relevant uses in the fields of biofuels (biogas, bioethanol, biohydrogen), in agriculture (biological pesticides, biofertilizers, biostimulants) and in other industries (bioplastics, biological enhanced oil recovery etc)

- *Acquire the capacity to critically evaluate situations and data available and the ability to plan and synthesize methods and processes in order to resolve environmental problems based on biotechnology*
- *Develop capacities for planning new biotechnological processes for the construction and production of novel products with low environmental footprint*

General Competences

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and are mentioned below), at which of the following does the course attendance aim?

Search for, analysis and synthesis of data and information by the use of appropriate technologies,	*Project planning and management*
Adapting to new situations	*Respect for diversity and multiculturalism*
Decision-making	*Environmental awareness*
Individual/Independent work	*Social, professional and ethical responsibility and sensitivity to gender issues*
Group/Team work	*Critical thinking*
Working in an international environment	*Development of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Introduction of innovative research	*(Other…….citizenship, spiritual freedom, social awareness, altruism etc.)*
	…….

The teaching methods followed and the course content encourage:

1) The search, analysis and composing of information with the use of relevant technologies
2) Adjustment to new and changing situtations
3) Decision making upon critical evalution of data and information available
4) Group working
5) Working in an international and multidisciplinary environment with final aim to resolve problems
6) Production of novel research ideas
7) Planning and management of constructions
8) Respect to environment and strengthening of environmental awareness

(3) COURSE CONTENT

The course will focus on the use of microorganisms as tools for the development of novel biotechnological products and processes with low environmental footprint. In particular

1. INTRODUCTION IN ENVIRONMENTAL MICROBIOLOGY AND MICROORGANISMS – TOOLS
2. ENVIRONMENTAL POLLUTANTS AND MICROBIAL TRANSFORMATIONS: Inorganic and organic pollutants, mechanisms of microbial degradation and transformation of organic pollutants
3. BIOREMEDIATION: Basic processes (co-metabolism vs growth linked catabolism), methods and application strategies (biostimulation, bioaugmentation) – examples, bioremediation of

metals (Cr, As, Se, Hg), radionucleids (U, Te), organic pollutants (PAHs, PCBs, pesticides, micropollutants, endocrine descriptive substances etc.), technological details in the application of bioremediation (in situ, ex situ methods).

4. USE OF FUNGI AND BACTERIA IN BIOREMEDIATION: White rot fungi – bacteria, uses, advantages and disadvantages.

5. PHYTOREMEDIATION: Fundamentals and description of main methods in phytoremediation (phytoaccumulation, phytofiltration, phytovolatilization), application problems.

6. ENVIRONMENTAL BIOTECHNOLOGY AND AGRICULTURE: Microorganisms as biological insecticides (*Bacillus thuringienis,* Baculoviruses). Microorganisms as biofungicides – Mode of Action (*Trichoderma sp. Pseudomonas fluorescens, Bacillus subtilis etc*). Microbes as biofertilizers and biostimulants – Symbiotic systems between plants and microorganisms (nitrogen fixing bacteria, arbuscular mycorrhizal fungi), Plant growth promoting rhizobacteria, mode of action, applications and problems.

7. ENVIRONMENTAL BIOTECHNOLGY AND BIOFUELS: Biogas, Bioethanol, Biohydrogen. Description of industrial processes and the role of microorganisms, biotechnological interventions for optimization

8. ENVIRONMENTAL BIOTECHNOLOGY AND INDUSTRIAL PROCESSES: Microbially enhanced oil recovery, biological leaching of metals, biopolymers production, production of biosurfactants biological bleaching and biopulping in paper industry

9. FUNDAMENTS OF SYNTHETIC BIOLOGY – Terminology and use of microorganisms in synthetic biology

10. SYNTHETIC MICROBIAL ECOLOGY AND APPLICATIONS – Terminology, fundamentals, applications in environmental bioremediation, fermentations for food and beverages production

11. BIOLOGICAL PROCESSES IN WASTEWATER TREATMENTS: Microbial growth in wastewater treatment systems, nitrification/denitrification, phosphorus removal, anaerobic microbial processes (Anammox, Methanogens)

(4) TEACHING METHODS-ASSESSMENT

MODES OF DELIVERY **Face-to-face, in-class lecturing, distance teaching and distance learning etc.**	In-class lecturing, face to face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY **Use of ICT in teaching, Laboratory Education, Communication with students**	Use of power point presentations Email communication with students Upload of literature, examination papers and teaching material through e-class
COURSE DESIGN **Description of teaching techniques, practices and methods:** **Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, Internship, Art Workshop,**	

Activity/Method	*Semester workload*
Lectures	39
Laboratory work	26
Theory study	35
Weekly individual evaluation reports for laboratory exercises	25

Interactive teaching, Educational visits, projects, Essay writing, Artistic creativity, etc. **The study hours for each learning activity as well as the hours of self-directed study are given following the principles of the ECTS.**	***Course total (25 hours of workload per credit unit)*** | ***125***
STUDENT PERFORMANCE EVALUATION/ASSESSMENT METHODS **Detailed description of the evaluation procedures:** **Language of evaluation, assessment methods, formative or summative (conclusive), multiple choice tests, short- answer questions, open-ended questions, problem solving, written work, essay/report, oral exam, presentation, laboratory work, other……etc.** **Specifically, defined evaluation criteria are stated, as well as if and where they are accessible by the students.**	**Students performance evaluation** • Through written exams at the end of the semester 80% of the final grade • The mean grades of students assignments in the frame of laboratory practicals contributes 20% of the final grade

(5) SUGGESTED BIBLIOGRAPHY:

-***Suggested bibliography***

• MICROBIOLOGY AND MICROBIAL TECHNOLOGY, Aggelis Georgios (STAMOULIS PUBLISHERS)
• ENVIRONMENTAL MICROBIOLOGY, Ntougias Spyridon, Aivatzlidis Alexandros, Melidis Paraschos (EMBRYO Publishing)

-***Complementary bibliography***

Lecture notes: presentations of the lectures and of the lab practicals are available in the e-class platform for all students to download