COURSE OUTLINE

1. GENERAL INFORMATION

FACULTY/SCHOOL	School of Plant Sciences		
DEPARTMENT	Department of Crop Science		
LEVEL OF STUDY	*Undergraduate*		
COURSE UNIT CODE	505	**Semester:**	9th
COURSE TITLE	Microbial 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**	**ECTS**
Lectures and Laboratory Exercises		3+2	5
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail under section 4			
COURSE TYPE *Background knowledge, Scientific expertise, General Knowledge, Skills Development*	Specialization courses titled "Applied Plant Physiology & Biotechnology of Microorganisms".		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION:	Greek		
LANGUAGE OF EXAMINATION/ASSESSMENT:			
THE COURSE IS OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://mediasrv.aua.gr/eclass/		

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 successful completion of the course the students will be able to:

- Understand the principles and methodologies required for genetic manipulation of microorganisms in the laboratory.
- Understand the principles and methodologies required for commercial production of natural products through the use of microorganisms.
- Understand the theory and tackle problems related to isolation and growth of microorganisms at laboratory and industrial scales.
- Understand the importance of microorganisms in agricultural systems, environmental applications and product development at industrial scale.

- Describe and interpret cutting - edge technologies used for the generation of products by prokaryotic and eukaryotic systems.
- Examine the factors affecting the successful development of products through the application of microorganisms in biotechnological approaches at laboratory and industrial scales.
- Describe, compare and evaluate various approaches and expression systems for the development of an industrial scale product.
- Understand cutting-edge methodologies used in biotechnological applications in agriculture, industry and environment by exploiting the potential of microorganisms.

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.)*
	…….

- Search for, analysis and synthesis of data and information by the use of appropriate technologies
- Decision making
- Individual/Independent work
- Group/Team work
- Work in a multidisciplinary environment
- Introduction of innovative research
- Project planning and management
- Environmental awareness
- Generating new research ideas
- Critical thinking
- Development of free, creative and inductive thinking
- Social awareness, professional and ethical responsibility, and sensitivity to gender issues

3. COURSE CONTENT

LECTURES:

1. Principles of microbial physiology
2. Principles of microbial biotechnology

2.1. Microorganisms as biosystems for the generation of plant-based products – Tools and methodologies of proteins production and reconstruction of metabolic pathways.

2.2. Omics and meta-omics: principles and methodologies of genomics, transcriptomics, proteomics and metabolomics.

2.3. Applications of bioinformatics in genomics, transcriptomics and proteomics.

3. Microbial fermentation in liquid substrates (kinetics of microbial growth and production) – Bioreactors (types, design, functionality, control, factors implicated in fermentation and optimization at industrial scale).

4. Microbial biosynthesis – Production of metabolites (primary and secondary metabolites, food and feed additives, vitamins and amino acids, fatty acids, alkaloids and isoprenoids, polyketides, coenzyme Q10, enzymes of industrial interest etc.).

5. Solid-state fermentations – Exploitation of plant (lignocellulosic) biomass by microorganisms.

6. Biodegradation (including detoxification) of pollutants and xenobiotics by microorganisms – Bioconversions of agricultural and agro-industrial byproducts.

7. Cultivation of edible and medicinal mushrooms.

8. Development of biofuels and biopolymers by exploiting microorganisms.

LABORATORY EXERCISES:

Laboratory exercises related to bioinformatics, primers design, PCR applications, bacterial transformation, expression of recombined proteins, bacterial conjugation, purification and electrophoresis of proteins, correction of mutations, biodegradation of lignocellulosics, determination of enzyme activities (e.g., related to cellulose degradation), fermentations in batch cultures and in lab-scale bioreactors. Training and becoming familiar with methodologies, analysis and presentation of results. Visit to commercial mushroom cultivation units.

4. TEACHING METHODS--ASSESSMENT

MODES OF DELIVERY *Face-to-face, in-class lecturing, distance teaching and distance learning etc.*	In-class lecturing.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY *Use of ICT in teaching, Laboratory Education, Communication with students*	Lecture presentations by using appropriate software and blackboard. Use of stereoscopes, microscopes, centrifuges, spectrophotometers, DNA and protein electrophoresis units, PCR units, fermenters, etc. Teaching aid and course delivery through the e-class asynchronous distance learning platform, and on-line databases etc.
COURSE DESIGN *Description of teaching techniques, practices and methods:* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, Internship, Art Workshop, 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.*	

Activity/ Method	Semester workload
Lectures	39
Laboratory practice	26
Individual project (data processing and compiling, and/or writing and presenting a report)	26
Personal study	34
Total of Course (25 hours of workload per ECTS)	***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.*	**I. Final written exam on the theory of the course** includes a combination of open-ended questions and multiple-choice questions. The final grade is the combined result of the evaluation of the written exam and the report presented. **II. The written examination in the laboratory part of the course** includes multiple choice tests, short- answer questions, open-ended questions, and/or problem solving.

5. SUGGESTED BIBLIOGRAPHY:

– Teaching notes provided by the teaching staff responsible for this course.

– Books (recommended publications):

- Glazer, A. and Nikaido, H. (2012). Microbial Biotechnology: Fundamentals of Applied Microbiology, 2nd Edition. Cambridge University Press.
- Arora, D.K. (2003). Handbook of Fungal Biotechnology (Mycology) 2003. CRC Press, New York.
- Kües, U. (2004). Genetics and Biotechnology (The Mycota, Volume 2). Springer, Berlin.
- Glick, B.R. and Pasternak, J.J. (2009) Molecular Biotechnology 3rd Ed. American Society of Microbiology Press.
- Yeoman, K., Fahnert, B., Lea-Smith, D. and Clarke, T. (2020). Microbial Biotechnology. Oxford Biology Primers, Oxford University Press.

6. TEACHERS:

-Theory:

- G. Zervakis (Professor, Agricultural Microbiology - Mycology),
- Chatzipavlidis (Professor, Environmental Microbiology),
- D. Georgakopoulos (Professor, Agricultural Microbiology),
- M. Dimou (Assistant Professor, Microbiology - Biotechnology of Microorganisms),
- A. Karnaouri (Assistant Professor, Microbial Fermentation - Molecular Biotechnology of Microorganisms).

-Laboratory:

- G. Zervakis (Professor, Agricultural Microbiology - Mycology),
- Chatzipavlidis (Professor, Environmental Microbiology),
- D. Georgakopoulos (Professor, Agricultural Microbiology),
- M. Dimou (Assistant Professor, Microbiology - Biotechnology of Microorganisms),
- A. Karnaouri (Assistant Professor, Microbial Fermentation - Molecular Biotechnology of Microorganisms),
- I. Kefalogianni (Laboratory Teaching Staff, Agricultural Microbiology - Soil Microbiology).