COURSE OUTLINE

1. GENERAL INFORMATION

FACULTY/SCHOOL	SCHOOL OF PLANT SCIENCE		
DEPARTMENT	CROP SCIENCE		
LEVEL OF STUDY	*Undergraduate*		
COURSE UNIT CODE	**267**	**Semester:**	7th
COURSE TITLE	SOIL MICROBIOLOGY		
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*	Background knowledge		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION:	Greek		
LANGUAGE OF EXAMINATION/ASSESSMENT:			
THE COURSE IS OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://oeclass.aua.gr/eclass/courses/EFP146/		

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*

The purpose of the course "Soil Microbiology" is to familiarize students with the objects described below on a theoretical and practical level so that, upon completion of the course, they will be able to:

1. Understand the significance of microorganisms in the soil ecosystem.

2. Recognize the function of microbial communities in the soil and the numerous interactions that develop between them and a variety of organisms (e.g. plants).
3. Have the ability to detect microorganisms in agricultural environments and detect and evaluate the diversity of soil microbes using a variety of methods and approaches.
4. Understand the fundamentals of microbial metabolism and be able to describe and explain the nitrogen metabolism in soil (ammonia, nitrification, and denitrification), as well as the metabolism of sulfur, phosphorus, and iron.
5. Understand the role of microorganisms in the carbon cycle, the decomposition of organic residues in soil, the significance of organic matter in soil fertility, methanogenesis, and carbon fixation in soil originating from pyrolysis.
6. Understand plant-microorganism interactions, particularly symbiotic nitrogen fixation, and mycorrhizal associations, as well as the function and significance of symbiotic (and non-symbiotic) bacteria and fungi.
7. Understand how soil microorganisms (such as nitrogen-fixing bacteria or mycorrhizae) may be employed in order to improve soil fertility, and also how microbial agents can be used to manage soil-borne plant diseases.
8. Recognize the significance and strategies of microbial degradation of xenobiotic compounds in soil, and additionally, the process by which microorganisms could potentially be used for bioremediation of contaminated and polluted environments.
9. Be able to describe and explain how aerobic controlled microbial fermentation of plant residues is applied to produce organic soil amendments and how those can be beneficial for agricultural applications (e.g., improving soil structure and increasing soil fertility, retaining soil-borne plant diseases, etc.).

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, analyze, and synthesize data and information by the use of appropriate technologies
- Decision-making, Independent work
- Environmental awareness
- Interdisciplinary collaboration
- Decision-making
- Free, creative, and critical thinking

3. COURSE CONTENT

LECTURES

1. Introduction: The significance of microorganisms in the environment of the soil. The essential role of soil microbes.
2. Ecology of soil microbial populations. Ecological categorizing of microbial community interactions.
3. The production of organic soil amendments by composting.
4. Procedures and methods for identifying and evaluating the microbial diversity in soil.
5. The carbon cycle, soil organic matter development, and microbial decomposition of organic debris. The contribution of organic matter to soil fertility. Methanogenesis. Biochar (role and production).
6. Soil nitrogen metabolism, including symbiotic and non-symbiotic nitrogen fixation (ammonification, nitrification, and denitrification).
7. Iron, phosphorus, and sulfur metabolism, etc.
8. The spermosphere and rhizosphere. The production and application of microbial inoculants.
9. Biological control of soil pathogens, symbiotic and non-symbiotic bacteria, and plant–soil microbe interactions.
10. Symbiotic and saprotrophic fungi - Mycorrhizal fungi.
11. Detection of microorganisms in agricultural habitats.
12. Metabolism of xenobiotic compounds in soil, bioremediation of contaminated soils.

LABORATORY EXERCISES

1. Thermophilic, aerobic degradation of organic residues (composting) in a box. Monitoring the progress of composting and measuring parameters.
2. Study of microbial communities in soil by direct microscopic observation (contact slide assay).
3. The role of microorganisms in the formation of soil aggregates.
4. The method of serial dilutions for the isolation and enumeration of soil microbial populations (dilution plates).
5. The Most Probable Number method for estimating the size of free-living nitrogen-fixing soil microbial populations (Most Probable Number).
6. Mycorrhizae (plant root system - fungi interactions).
7. Antibiotics. Modes of action of antagonistic bacteria against soil-borne plant pathogenic fungi.
8. Nitrogen metabolism in soil. Symbiotic and non-symbiotic nitrogen fixation.
9. Genomic DNA isolation from soil samples and applications.
10. Processing of composting results, determination of mature compost parameters.

4. TEACHING METHODS--ASSESSMENT

MODES OF DELIVERY *Face-to-face, in-class lecturing, distance teaching and distance learning etc.*	Theory lectures of the course are held in the teaching auditorium. The practical exercises are carried out in the Microscopy Classrooms of the Laboratory of General & Agricultural Microbiology, as well as the greenhouse's composting facilities, where the preparation of organic soil amendment (compost) takes place.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY *Use of ICT in teaching, Laboratory Education, Communication with students*	Use of PowerPoint slides. Communication with students face-to-face and via e-mail. Supporting the learning process through access to e-class, online 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	13x3=39
Laboratory practice	13x2=26
Field exercise and report writing	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. Written test on course theory, including: 1. Written final examination The examination will include a combination of multiple-choice and/or short-answer questions (100%). II. The practical part of the course is assessed through assignments and a final written examination.

5. SUGGESTED BIBLIOGRAPHY:

Greek language bibliography

1. Brock's Biology of Microorganisms, M.T. Madigan, J.M. Martinko, K.S. Bender, D.H. Buckley & D.A. Stahl, (2nd edition), Crete University Press (2018).
2. Zervakis, G.I. Introduction to Mycology. University Notes (3rd edition), AUA, Department of Plant Production Science (2019)
3. Kirchman D.L. Microbial ecology Crete University Press (2021).

English language bibliography

1. Alexopoulos, C.J., Mims, C.W. and Blakwell, M. (1996). Introductory Mycology (4th Edition). J. Wiley & Sons Inc., New York - U.S.A.
2. Atlas, R. M. and Bartha R. (1998). Microbial Ecology, Fundamentals and Applications (4th Edition). Benjamin/Cummings Science Publishing, California, USA.
3. Deacon, J.W. (2013). Fungal Biology (4th Edition). Blackwell Publishing, Oxford - U.K.
4. Kirk, P.M., Cannon, P.F., Minter, D.W. and Stalpers, J.A. 2008. Dictionary of the Fungi (10th Edition). CAB International. U.K.
5. Sylvia, D. M., Fuhrmann, J. J., Hartel, P. G. and Zuberer, D. A. (1998). Principles and Applications of Soil Microbiology. Prentice – Hall, USA.
6. Van Elsas J.D., Trevors J.T., Soares Rosado A. and Nannipieri P. (2019) Modern Soil Microbiology 3rd edition, CRC Press

6. TEACHERS:

Lectures:

G. Zervakis (Professor, Agricultural Microbiology - Mycology),
I. 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).

Laboratory exercises:

G. Zervakis (Professor, Agricultural Microbiology - Mycology),
I. 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).