COURSE OUTLINE

1. GENERAL INFORMATION

FACULTY/SCHOOL	**SCHOOL OF PLANT SCIENCES**		
DEPARTMENT	Faculty of Crop Science		
LEVEL OF STUDY	Undergraduate		
COURSE UNIT CODE	**316**	**Semester:**	**7º**
COURSE TITLE	**ENVIRONMENTAL POLLUTION**		
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**
		3	3
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*	*Scientific expertise*		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION:	Greek		
LANGUAGE OF EXAMINATION/ASSESSMENT :	Greek		
THE COURSE IS OFFERED TO ERASMUS STUDENTS	https://oeclass.aua.gr/eclass/courses/EFP145/		
COURSE WEBSITE (URL)	http://efp.aua.gr/el/mathima/192		

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:

Among the objectives of the course, students who successfully attend it are expected to:

- Understand the significance of major environmental issues in modern society.
- Gain a deep understanding of the causes and consequences of air pollution, soil pollution, freshwater pollution, and marine pollution.
- Acquire knowledge about the phytotoxicity of pollutants and their impacts, both biological and economic, especially on cultivated species.
- Familiarize themselves with methods of biological monitoring and assessment to evaluate disturbances, alterations, and stresses at the species, community, and ecosystem levels.

- Learn about the applications of bioindicators-biomonitors, with an emphasis on using plants to monitor environmental quality.
- Understand the methods of phytoremediation, which involve the use of plants in the purification and restoration of disturbed areas.

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*

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

The course aims to develop the following general skills:

- Respect for the natural environment
- Design and project management skills
- Promoting work in an international environment
- Promoting work in an interdisciplinary environment
- Encouraging free, creative, and inductive thinking

3. COURSE CONTENT

1. INTRODUCTION - General concepts of the biotic and abiotic Environment - The concept of Pollution - Definitions. Historical overview of pollution - Measurement units of pollution.
2. SOIL POLLUTION AND DEGRADATION - Heavy metal pollution - Nitrogen pollution - Radioactive pollution - Soil erosion - Desertification, causes and consequences with an emphasis on the consequences in agriculture.
3. WATER AND MARINE POLLUTION - Pollution from nutrient salts - Eutrophication phenomenon - Dissolved Oxygen - Biochemical Oxygen Demand (BOD) - Fertilizers, Pesticides (insecticides, herbicides, etc.), Pollution from waste microorganisms - Pollution from nutrient salts - Pollution from toxic metals - Bioaccumulation - Biomagnification. The case of mercury. Thermal pollution. Pollution from Organic substances (Chlorinated compounds - Petroleum). Accidents related to agriculture (Bhopal disaster, Seveso disaster, Rhine River accident). Pollution from ship accidents or offshore oil extraction systems - Remediation methods - Impacts on aquatic organisms.
4. ATMOSPHERIC POLLUTION. Sources of atmospheric pollution - Primary and secondary pollutants - Types of atmospheric pollution - Photochemical pollution (Los Angeles-type) - Smog pollution (London-type). Historically lethal episodes of atmospheric pollution - The case of London. Transfer of atmospheric pollution - Transboundary pollution - The grasshopper effect phenomenon. Urban pollution - The phenomenon of temperature inversion. The "smog" of Athens.
5. SIGNIFICANT ATMOSPHERIC POLLUTANTS. Carbon monoxide (CO) - Sources of CO, distribution of CO in the atmosphere - Effects of CO on plants and humans - toxicity limits. Nitrogen oxides (NOx) - Sources of NOx - distribution of NOx in the atmosphere - Effects of NOx on plants and humans - toxicity limits. Sulfur oxides (SOx) - Sources of SOx - distribution of SOx in the atmosphere - Effects of SOx on plants and humans - toxicity limits. Acid rain. Impact of acid rain on aquatic ecosystems - Effects of acid rain on plants, birds, cultural heritage. Ozone (O3). The ozone hole phenomenon - impacts - protection of the stratospheric O3 layer. Tropospheric O3 as a photochemical pollutant - formation - spatiotemporal variation. Impacts of O3 on human health. O3 as a phytotoxic pollutant - the AOT40 phytotoxicity index. Chlorofluorocarbons (CFCs) - Methyl bromide (MeBr) - Peroxyacetyl nitrate (PAN) - Volatile hydrocarbons (VOCs). Particulate pollution (PMS) - Impacts of particulate pollution on agriculture. Hydrocarbons. Mercury. Atmospheric oxidation - The role of hydroxyl radicals (OH).
6. CLIMATE CHANGE - THE "GREENHOUSE EFFECT" phenomenon. Climate forcing. Greenhouse gases. Carbon dioxide (CO2). Water vapor as a greenhouse gas. Methane (CH4) - Methane hydrates. Nitrous oxide or Nitrogenous oxide (N2O). Climate change and agriculture.
7. ENVIRONMENTAL QUALITY INDICATORS - BIOINDICATORS-BIOMETRICS for monitoring environmental quality.
8. PHYTOREMEDIATION - Bioremediation. Utilization of hyperaccumulator plants of metals.
9. ENVIRONMENTAL TOXICOLOGY - Ecotoxicology. Ecological risk assessment. The phenomenon of bioaccumulation in toxicology.

4. TEACHING METHODS--ASSESSMENT

<table>
<tr><td>MODES OF DELIVERY
Face-to-face, in-class lecturing, distance teaching and distance learning etc.</td><td>In the amphitheater.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY
Use of ICT in teaching, Laboratory Education, Communication with students</td><td>Use of PowerPoint and video

Communication with students through:
✓ email,
✓ the e-class website,
✓ the Open class platform, and
✓ the announcements website of the Agricultural University of Athens: http://tdd.aua.gr/announcements/main</td></tr>
<tr><td>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.</td><td>
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<tr><th>Activity/ Method</th><th>Semester workload</th></tr>
<tr><td>Theory lectures</td><td>13 weeks</td></tr>
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<tr><td>Total number of teaching hours:</td><td>39 hours</td></tr>
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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. The evaluation language is Greek. II. The grade in theory is determined either 100% by the final written exam or 20% by completing a project and 80% by the final written exam. III. Examinations may consist of short answer questions, multiple-choice questions, or mixed (i.e., multiple-choice questions + problem-solving or essay questions). IV. Oral examination is offered to those who prefer this method of examination for whatever reason (e.g., for health problems or any other reasons).

5. SUGGESTED BIBLIOGRAPHY:

University Textbooks:

"Environmental Protection Topics" - Author: Sotirios E. Tsiouris "Principles of Environmental Chemistry" by James Girard - Edited by: M. Polysios, P. Tarantilis, X. Pappas. Scientific Editions Parisianou S.A.

The part of the material concerning Environmental Toxicology is covered by the textbook: "Ecotoxicology and Environmental Toxicology" by Ath. Valavanidis, 2007. Edition: Department of Chemistry, University of Athens. It is freely available by the Author, in electronic form, at the following websites: http://chem-tox-ecotox.org/wp-content/uploads/2017/02/Ecotox-and-Environ-Toxicol.pdf http://195.134.76.37/old_site_10-7-2016/courses/organiki_1/val_oikotox.htm

University Notes: "Management and Protection of the Environment" - Authors: K. Saitanis, A.N. Rigas-Karandinos, and G. Arapis.

Relevant scientific journals:

- Environmental Pollution
- Environmental Science and Pollution Research
- Environmental Monitoring

6. TEACHERS:

Professor Costas SAITANIS