COURSE OUTLINE

1. GENERAL

SCHOOL	SCHOOL OF ENVIRONMENT & AGRICULTURAL ENGINEERING		
ACADEMIC UNIT	NATURAL RESOURCES MANAGEMENT &AGRICULTURAL ENGINEERING		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	81	SEMESTER	7th
COURSE TITLE	ENVIRONMENTAL SOIL PHYSICS		

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/ Laboratory exercises	3+2	5
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*	Special background
PREREQUISITE COURSES:	Soil Physics
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://oeclass.aua.gr/eclass/courses/AFPGM153/

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 Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course aims to introduce students to the basic concepts and mechanisms of solute, gas and heat transfer in porous media. It aims to understand the role and processes in the unsaturated zone for the rational application of irrigation and agricultural practices addressing pollution problems and ensuring optimal conditions for the crops and the protection of groundwater and the environment.

In particular, the scope of the course includes:

- Basic knowledge of the principles and mechanisms of solute transport, entering the soil from various sources (natural, industrial, domestic and agricultural) and their interactions with the soil environment, physical, chemical processes and transformations that modify the concentrations of solutes in the soil solution and regulate their movement and transport through the unsaturated zone to groundwater. Solution of basic mass transfer equations and applications to the movement of water, salts, nutrients, pesticides and other contaminants in the unsaturated zone to groundwater.
- Basic principles and law of heat transfer, parameters involved in the formation of the temperature regime in the soil, as well as the main mechanisms of gas transport in the soil.
- Basic techniques for the use of soil as a medium for treatment of liquid effluents and wastes and

the quality criteria and potential for the use and disposal of treated wastewater.

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

- Understand the basic parameters and laws governing the movement of water and contaminants in the unsaturated zone and the mechanisms of contaminant transport to soil and groundwater
- They will be able to handle questions related to the thermal regime and to the proper aeration conditions in the soil.
- They will be able to handle irrigation water quality management issues, be aware of the problems and techniques for the proper application of irrigation water, especially of degraded water quality or treated effluents to ensure the sustainability of agriculture and the protection of natural resources.

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Decision-making
Working independently
Team work
Respect for the natural environment
Production of free, creative and inductive thinking

3. SYLLABUS

Transfer of solutes in the unsaturated zone.

Movement of water in porous media. Mechanisms and mathematical description of mass transfer of substance in the three phases, adsorbed, water soluble and gaseous in porous media. Mass flow, diffusion, hydrodynamic dispersion. Dispersion coefficient. Mass transfer by adsorption and transformations of the substance. Analytical solutions of differential dispersion equation for different initial and boundary conditions (from a source of constant and varying concentration, by adsorption and substance transformation, with moving and stagnant water). Miscible displacement and effluent curves. Mathematical models of mass transfer. Movement of water and salts in the unsaturated zone, irrigation water management. The role of the unsaturated zone in the transport of pesticides, fertilizers and groundwater pollution. Use of mathematical models CFITM, HYDRUS

Heat flow in soil.

Soil temperature, thermal properties of soils and their determination, thermal conductivity, thermal diffusivity, Determination of heat flux density in soil. Radial heat flow. Solutions of heat flow equation under various initial and boundary conditions (sinusoidal, periodic upper boundary function and abrupt change in soil surface temperature) analytical and numerical solutions.

Soil gas phase.

movement of soil air, diffusion of gases in the soil, determination of the diffusion coefficient.

Recovery and reuse of wastewater.

Physical treatment systems

Natural wastewater treatment systems.Characteristics and types of treatment systems. Use for irrigation Use for groundwater recharge.

Laboratory work include:
- experiments to determine the parameters and experimentally verify the mechanisms and laws mentioned in the theoretical part of the course
- exercises and applications of the methodologies discussed in the theoretical part of the course and individual work on selected topics.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face in class and Laboratory
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching. Laboratory exercises in student groups. Communication with students directly and by mail. Use of the e-class of the course.
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
Laboratory experiments/ Exercises and applications	26
Individual practice projects	15
Individual study	45
Course total	***125***

STUDENT PERFORMANCE 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 they are accessible to students.*	Evaluation of theory (50%) - Final written examination Evaluation of Laboratory work (50%) - Final written examination (exercises) - Grade of assigned projects

5. ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Antonopoulos V.. «Quality and pollution of groundwater» 1999. ZITI Publications
2. Hillel, D. « Introduction to Environmental Soil Physics» Elsevier Academic Press, Amsterdam, 2004.
3. Radcliffe, D. E., & Simunek, J. (2018). Soil physics with HYDRUS: Modeling and applications. CRC press.

- *Related academic journals:*

Journal of Contaminant Hydrology
Soil Science Society of America Journal