COURSE OUTLINE

1. GENERAL

SCHOOL	Environment and Agricultural Engineering		
ACADEMIC UNIT	Natural Resources Management and Agricultural Engineering		
LEVEL OF STUDIES			
COURSE CODE	**1520**	**SEMESTER**	**9^{0}**
COURSE TITLE	Drainage		

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 and Practical Exercises	5	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*	Scientific Area, Skills Development
PREREQUISITE COURSES:	SOIL PHYSICS
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

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 purpose of the course is the design of drainage systems taking into account theoretical knowledge from the movement of groundwater and the existing theories that have been developed for the cases of steady state and non-steady state drainage with the ultimate goal of maintaining the groundwater level below the zone of root layer to improve the productivity of agricultural soils.

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

●Understand the basic concepts of groundwater movement and the factors that affect the design of a drainage network.

●Has knowledge of the methods of calculating the spacing of third-order drainage pipes in the case of steady state and non-steady state drainage.

●Able to calculate the hydraulic characteristics of a piped or trench drainage system.

●Can draw and calculate a drainage network.

●Gain knowledge about the effects of drainage on soil physical properties and crop yields.

●Acquire knowledge on the application of drainage to control soil salinity and the remediation of problematic soils as well as the planning of organic soil drainage.

● Take into account the protection of the environment in the planning of the drainage of the lands, to contribute to the sustainability of agriculture by applying management techniques that will minimize the pollution of water resources from the runoff of the drainage networks.

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…*
	…….

- Project planning and management
- Analyze and process project information
- Ability to work independently and as part of a team
- Work in a multidisciplinary environment

3. SYLLABUS

Introduction (Definition of drainage, causes that create the problem of drainage and reasons that force its application).
Basic concepts of groundwater movement.
Measurement of hydraulic conductivity at saturation in the field.
Calculation of the spacing of drainage pipes and open ditches in steady state drainage (Analysis by Dupuit - Forchheimer, Hooghoudt, Ernst, Kirkham, Hooghoudt - Ernst).
Calculation of spacing of drainage pipes and open ditches in non-steady state drainage (Specific performance, derivation of Boussinesq's equation, Boussinesq's analytical solution, Glover's first approximation method, Glover - Dumm's simplified method, Van Schilfgaarde's analytical solution).
Drainage systems - networks (Factors influencing the design of a drainage system, types of drainage systems, design of drainage systems, construction of drainage systems, drawing and study of a drainage network with pipes and open ditches).
Drainage and physical properties of the soil (structure, aeration, temperature, organic matter). Water table depth and crop yield.
Drainage to control soil salinity. Remediation of saline soils and leaching techniques. Remediation of alkaline soils. Drainage of organic soils.
Environmental aspects of drainage. Effects on the quality of water receivers, soils and wetlands. Drainage water management to protect the environment. Environmental Impact Assessment. Reuse of drainage water for irrigation.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	In classroom and laboratory.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES.**
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*	
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.*	I. Theory (50%) Laboratory (50%) II. The examination of the theory includes: Short answer questions and Solving exercises for the calculation of the spacing of third-order drain pipes. III. The examination of the laboratory includes: Drawing and calculation of a drainage system with underground pipelines, drawing and calculation of the mecotomy of a main trench of a drainage network and other exercises related to the subject.

Activity	***Semester workload***
Lectures	65
Practical exercises that focus on the application of methodologies and analysis of case studies in smaller groups of students	30
Case study	30
Total Course	***125***

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
Irrigation and Drainage Engineering ISBN 978-3-319-05698-2
Peter Waller and Muluneh Yitayew
- Related academic journals:

Journal of irrigation and drainage engineering (ASCE)
Irrigation and Drainage ICID
Agricultural water management