COURSE OUTLINE

1. GENERAL

SCHOOL	SCHOOL OF ENVIRONMENT & AGRICULTURAL ENGINEERING		
ACADEMIC UNIT	NATURAL RESOURCES MANAGEMENT &AGRICULTURAL ENGINEERING		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**249**	**SEMESTER**	**7th**
COURSE TITLE	GROUNDWATER HYDRAULICS		
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		2+1	3
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:	Hydraulics, Applied Mathematics		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://oeclass.aua.gr/eclass/courses/285/		

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 analyses the hydrological and geological factors that control the flow of groundwater and the rational use for social purposes, sustainability and development of groundwater. Applications for sustainable use of groundwater resources and groundwater remediation are introduced.
Upon successful completion of the course, students will be able to
-understand the basic concepts of underground fluid flow in general and water in particular, with the application of techniques and technologies for its use.
- solve basic hydrogeological problems.
- obtain an overview of current issues in the field of underground hydrology and hydraulics and the available technologies for the remediation of hydrogeological systems.

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
Adapting to new situations
Decision-making
Working independently
Team work
Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism

Working in an international environment *Working in an interdisciplinary environment* *Production of new research ideas*	*Production of free, creative and inductive thinking* *……* *Others…* *…….*

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Decision-making
Working independently
Teamwork
Respect for the natural environment

3. SYLLABUS

- Hydrological cycle and groundwater.
- Types and properties of aquifers.
- Groundwater flow (Derivation of general flow equations - Hydraulic characteristics of aquifers - Homogeneity and isotropy, Compression, Flow in saturated media. Analytical solutions. Flow Nets, Flow in Unsaturated porous geological formations.
- Steady and unsteady state flow.
- Hydraulics of wells, Pressurized aquifers, Analytical solution, Pressurized aquifer tests. Well hydraulics, free aquifers, analytical solution, free aquifer test. Hydraulics of sustainable watering techniques, monitoring and data processing.
- Groundwater quality. Groundwater pollution. Contaminant transport, analytical solutions in groundwater aquifers of geological formations.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
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. Applications for each topic. Solving of simple examples and problems in the classroom. Discussion of case studies. Calculations on PC via Excel and computational codes.
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*	Final written exam in theory (50%)

Activity	***Semester workload***
Lectures	26
Laboratory (Applications- Exercises)	13
Assignments (project-reports)	14
Autonomous study	29
Course total	***75***

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.*	For Laboratory work (50%) - Final written exam (exercise) - Grade of assigned projects

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Τερζίδης Γ.Α. και Καραμούζης. 1985. Υδραυλική υπόγειων νερών. Εκδόσεις Ζήτη.
- Κουτσογιάννης Δ. και Θ. Ξανθόπουλος, Τεχνική Υδρολογία, ΕΜΠ. http://www.itia.ntua.gr/en/docinfo/115/
- Freeze R.A. and J.A. Cherry, 1979. Groundwater. Prentice Hall.
- Todd D.K. and L.W. Mays, 2005. Groundwater Hydrology, Third Edition. Wiley.
- Fetter, C.W.,2000. Applied Hydrogeology, Fourth Edition. Prentice Hall.
- Schwartz W.and H. Zhang, 2003. Fundamentals *of Groundwater. John Wiley and Sons, New York*