COURSE OUTLINE

1. GENERAL

SCHOOL	School of Engineering		
DEPARTMENT	Department of Environmental Engineering		
LEVEL OF STUDIES	6		
COURSE CODE	**15ZY3N-K2**	**SEMESTER**	**7**
COURSE TITLE	Applied and Groundwater Hydraulics		

TEACHING ACTIVITIES *If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	6	5
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.		

COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	Scientific Area, Skill Development
PREREQUISITES:	Fluid Mechanics
TEACHING & EXAMINATION LANGUAGE:	Greek
COURSE OFFERED TO ERASMUS STUDENTS:	No
COURSE URL:	https://eclass.duth.gr/courses/TMC342/

2. LEARNING OUTCOMES

Learning Outcomes

Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.

- Understanding of the closed conduit hydraulics and of the open channel hydraulics
- Understanding of the methods for solving of problems related to applied hydraulics
- Understanding of the principles of groundwater hydraulics

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information, ICT Use
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Project design and management
Equity and Inclusion
Respect for the natural environment
Sustainability
Demonstration of social, professional and moral responsibility and sensitivity to gender issues
Critical thinking
Promoting free, creative and inductive reasoning

Sizing of closed pipes
Dimensioning of pipes
Dimensioning of open channels
Design of hydraulic structures

3. COURSE CONTENT

1. Introduction. Application of Hydraulics to the Environmental Engineering Science, computation of head losses, use of the Moody diagram. Use of the Colebrook-White equation.
2. Computation of minor losses.
3. Hydraulics of flow between two tanks connected by a closed conduit
4. Regulation of the flow-rate by the use of valves. Hydraulic behaviour of a system three tanks connected by closed pipes. Hydraulics of pumps.
5. **Open Channel Hydraulics**. The Bernoulli equation for free surface flows. The Manning equation for head losses computation. Subcritical and supercritical flows. Flow depth computation for the case of negligible energy losses
6. The case of uniform (normal) flow. Flow depth computation for the case of a channel with an orthogonal cross-section by using the Newton-Raphson method. Computation of the flow depth for the case of a channel with a trapezoidal cross-section
7. Flows with gradually changing flow depths. Types of curves for gradually changing depths M1, M2, M3, S1, S2, S3. Computation of the flow characteristics for gradually changing flow depths. Cross-sections which control the flow conditions.
8. Hydraulic jumps. Types of hydraulic jumps. Computation of flow characteristics and energy losses in the hydraulic jump case. Practical applications.
9. Weir hydraulics. Hydraulics of waste water treatment plants.
10. Significance of underground water resources**. Simulation of underground water resources**. Porous media and the equivalent continuum approach. The Darcy law. The Forchheimer law. Simulation of flows in fractures. The double porosity model. The discrete fracture simulation approach.
11. The continuity (mass balance) equation for confined and unconfined aquifers. The Boussinesq equation. Solutions to the one-dimensional transient equations for groundwater flows. Application to the interactions between aquifers and water bodies.
12. Two-dimensional steady-state and transient flows in aquifers. The method of images. Multi-well problems. The method of images. The Theis equation.
13. Mass transfer in groundwater aquifers. Simulation of dispersion processes in aquifers. Heat transfer in groundwater aquifers and exploitation of geothermal energy

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD *Face to face, Distance learning, etc.*	Face to face
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) *Use of ICT in Teaching, in Laboratory Education, in Communication with students*	**Use of ICT in Teaching, in Laboratory Education, in Communication with students**
TEACHING ORGANIZATION *The ways and methods of teaching are described in detail.* *Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research & analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc.*	

Activity	*Workload/semester*
Lectures	50
Exercises in class	28
Study and analysis of bibliography	45
Exercises at home	27

The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.		
STUDENT EVALUATION *Description of the evaluation process* *Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others* *Please indicate all relevant information about the course assessment and how students are informed*	Course evaluation is based on the final exam	

5. SUGGESTED BIBLIOGRAPHY

Terzidis G. *Applied Hydraulics*. Ziti Editions. In Greek

Bear J., (1986) «*Groundwater Hydraulics*», McGraw Hill

Sylaios G. & Moutsopoulos K. «*Environmental Computational Fluid Mechanics*», 2015, KALLIPOS e-book. In Greek

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	
Contact details:	
Supervisors: (1)	
Evaluation methods: (2)	
Implementation Instructions: (3)	

(1) Please write YES or NO

(2) Note down the evaluation methods used by the teacher, e.g.

- *written assignment* or/and exercises
- written or oral examination with distance learning methods, provided that the integrity and reliability of the examination are ensured.

(3) In the **Implementation Instructions** section, the teacher notes down clear instructions to the students:

a) in case of **written assignment and / or exercises:** the deadline (e.g. the last week of the semester), the means of submission, the grading system, the grade percentage of the assignment in the final grade and any other necessary information.

b) in case of **oral examination with distance learning methods:** the instructions for conducting the examination (e.g. in groups of X people), the way of administration of the questions to be answered, the distance learning platforms to be used, the technical means for the implementation of the examination (microphone, camera, word processor, internet connection, communication platform), the hyperlinks for the examination, the duration of the exam, the grading system, the percentage of the oral exam in the final grade, the ways in which the inviolability and reliability of the exam are ensured and any other necessary information.

c) in case of **written examination with distance learning methods**: the way of administration of the questions to be answered, the way of submitting the answers, the duration of the exam, the grading system, the percentage of the written exam of the exam in the final grade, the ways in which the integrity and reliability of the exam are ensured and any other necessary information.

There should be an attached list with the Student Registration Numbers only of students eligible to participate in the examination.