COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
DEPARTMENT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE – 7		
COURSE CODE	**ΟΕΑ4ΕΠ**	**SEMESTER**	**9th (Fall)**
COURSE TITLE	SOIL AND GROUNDWATER REMEDIATION FROM HAZARDOUS WASTE		

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**
Lectures	3	
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.	3	5

COURSE TYPE *Background, General Knowledge, Scientific Area, Skill Development*	Skill development
PREREQUISITES:	Aquatic chemistry, Mathematics-I, Unit operations, Unit processes
TEACHING & EXAMINATION LANGUAGE:	Greek
COURSE OFFERED TO ERASMUS STUDENTS:	Yes
COURSE URL:	https://eclass.duth.gr/courses/TMC291/ **in GREEK**

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.

1. Knowledge based

- The objective of the course is to present a quantitative treatment from the design point of view of the most important technologies, used for remediation of soil and groundwater contaminated with hazardous waste. The emphasis is on *in-situ* technologies.
- Understanding the behavior of dissolved and non-aqueous phase contaminants in soil and groundwater.
- Understanding the methodology for risk assessment and remediation of uncontrolled landfills.
- Understanding the approach to solution of typical environmental problems from mining activities.

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

2. **Skills/Competences acquired**

- Following the successful completion of this course, the student will be in a position to evaluate, combine and select the different remediation technologies, which were mentioned above.
- Ability to compute contaminant transport in subsurface systems.
- Ability to conduct basic calculations required for preliminary design of remediation technologies, which were mentioned above.
- Ability to conduct risk assessment calculations for uncontrolled landfills.

3. COURSE CONTENT

1. Solute mass transfer in saturated porous media
2. Advection-dispersion-sorption-reaction equation – initial and boundary conditions – analytical solutions
3. Control of contamination source
4. Overview presentation of groundwater remediation technologies (pump-and-treat, *in-situ* chemical treatment, *in-situ* biological treatment, *in-situ* stripping, bioslurping)
5. Pump-and-treat of contaminated groundwater
6. Non-Aqueous Phase Liquids in subsurface systems: Movement and physical-chemical behavior
7. *In-situ* active walls and "funnel and gate" systems
8. Bioremediation of contaminated groundwater
9. Overview presentation of soil remediation technologies (thermal treatment, physical-chemical treatment, biological treatment, phytoremediation, natural attenuation)
10. Soil vapor extraction
11. Soil bioremediation technologies
12. Uncontrolled landfill remediation: risk assessment
13. Uncontrolled landfill remediation: technologies
14. Approach to solution of environmental problems from mining activities – I
15. Approach to solution of environmental problems from mining activities – II

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD *Face to face, Distance learning, etc.*	Face-to-face teaching of course contents, using overhead transparencies and blackboard. Instructor's text in electronic form and complementary design exercises are accessed through the e-class platform.
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) *Use of ICT in Teaching, in Laboratory Education, in Communication with students*	Use of videos for presenting modern technology topics, such as new equipment/technologies, and of e-class for 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.* *The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.*	

Activity	*Workload/semester*
Lectures	39
Bibliographic research and analysis	78
Individual study	33
TOTAL	**150**

STUDENT EVALUATION *Description of the evaluation process*	Essay development questions: 15%

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*	Problem Solving: 65% Written assignment: 20%

5. SUGGESTED BIBLIOGRAPHY

Voudrias, E.A. “Soil and groundwater remediation from hazardous waste”, class notes published by Democritus University of Thrace

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Evangelos Voudrias
Contact details:	6976-320662, voudrias@env.duth.gr
Supervisors: (1)	YES
Evaluation methods: (2)	Written examination with distance learning methods, provided that the integrity and reliability of the examination are ensured. Written individual study.
Implementation Instructions: (3)	Written open-book examination with distance learning methods, using e-class to administer the questions to be answered and problems to be solved. Students write their answers/solutions on paper and then take pictures and convert them to pdf files, using their smart phone. Then they submit their pdf files to the instructor using the e-class system. As an alternative, they can type their answers in word files and submit them using the e-class platform. Students are randomly separated in groups of five and each group is given different problems to solve. Problems and questions are given successively and not all of them together. Each problem/question is assigned the due response time. At the end of this time, students have to submit their answers. Then the next set of problems/questions is given with a defined response time. Students communicate with the instructors through the skype or skype for business platforms, operating in parallel with e-class. The instructors go through participant identification in the beginning and can check the participant's identity any time during the 3-hour duration of the exam. The degree of difficulty is higher than usual live participation examination. In order to participate, students have to solemnly declare through the university system that they agree with this type of examination. A list with the eligible student registration numbers and names is sent to the instructor before examination. The evaluation method is the same with student evaluation in normal circumstances presented above.

(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.