

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
DEPARTMENT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE – 7		
COURSE CODE	ΟΕΑ3ΕΠ	SEMESTER	8 th (Spring)
COURSE TITLE	HAZARDOUS WASTE TECHNOLOGY AND MANAGEMENT		
TEACHING ACTIVITIES <i>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.</i>	TEACHING HOURS PER WEEK	ECTS CREDITS	
Lectures	3		
Laboratory	3		
Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.	6	5	
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	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/TMC287/ 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

- Understanding of the principles of science and technology, which constitute the basis of Integrated Hazardous Waste Management.
- Familiarization with the European and Greek legislation, which deals with hazardous waste management.
- Understanding of the definition and the characteristics, which render a waste hazardous, as well as indicative characterization tests.
- Quantification of acute and chronic toxicity and risk assessment for carcinogens and non-carcinogens.
- Understanding of the management facilities and of the method used to determine incompatibility of hazardous waste during storage, collection and transport.
- Understanding of the basic treatment technologies for hazardous waste, such as stabilization/solidification, incineration, chemical oxidation, neutralization and sanitary landfilling.
- Case studies, such as the management of waste from healthcare facilities.

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

Project design and management

Equity and Inclusion

Respect for the natural environment

Decision making

Autonomous work

Teamwork

Working in an international environment

Working in an interdisciplinary environment

Production of new research ideas

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 decide whether a particular waste is hazardous and how it should be managed.
- The student will be in a position to recognize the basic hazardous waste streams produced in Greece.
- The student will be able to recognize some of the most frequent hazardous substances (e.g., solvents, pesticides, explosives, etc.), which render a waste hazardous.
- Ability to compute risk assessment for hazardous waste.
- Ability to select the best available technology for treatment of a particular hazardous waste.
- Ability to compute mass and energy balances in hazardous waste combustion facilities.
- Ability to design a management system for waste from healthcare facilities.

3. COURSE CONTENT

1. Introduction and evolution in hazardous waste management – landmark mismanagement episodes – definitions – hazardous waste management systems – European and Greek legislation – European Waste Catalogue – Basel Convention
2. Examples of hazardous waste – categories of hazardous chemical substances – toxicity – dose-response curves – risk assessment – Tox town
3. Sampling – characteristics – hazardous waste characterization methods – flammability limits – flash point – TCLP test – European leaching test
4. Hazardous waste production (sources, kinds) – production rates in Greece and in the European Union – clean production – waste minimization – pollution prevention
5. Temporary storage – labeling – separation and treatment at the source – recycling – environmental impact – examples
6. Hazardous waste collection – transport and transfer stations – transboundary transport – labeling during transport – chemical compatibility – facilities for hazardous waste management – environmental impact
7. Process overview for hazardous waste treatment – physical – chemical – biological – thermal processes
8. Sabilization-solidification of hazardous waste – mechanisms – additives – effectiveness – field applications – environmental impact
9. Incineration – mass and energy balances – types of incineration systems – environmental impact
10. Hazardous waste sanitary landfilling – waste acceptance criteria – lining systems – disposal methods – gas and leachate management – landfill covers – environmental monitoring – environmental impact
11. Neutralization – adsorption – ion exchange – design
12. Oxidation – hydrogen peroxide with UV radiation – ozone with UV radiation – design – examples – treatment of cyanide waste
13. Management of waste from healthcare facilities – legislation – classification – collection and transport – treatment technologies – cost
14. Management of asbestos waste

HAZARDOUS WASTE LABORATORY (Laboratory support by Ioannis Papsyros)

1. Laboratory safety rules
2. Acid digestion of hazardous waste
3. Leaching test of hazardous waste as a function of pH-I
4. Leaching test of hazardous waste as a function of pH-II

5. Soil washing for removal of hazardous contaminants
6. Advanced chemical oxidation of hazardous waste using the Fenton reagent
7. Speciation modeling of hazardous waste

4. LEARNING & TEACHING METHODS - EVALUATION

<p>TEACHING METHOD <i>Face to face, Distance learning, etc.</i></p>	<p>Face-to-face teaching of course contents, using overhead transparencies and blackboard. Complementary design exercises are accessed through the e-class platform. The course, also, includes a laboratory section with required submission of technical reports.</p>																			
<p>USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) <i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i></p>	<p>Use of videos for presenting modern technology topics, such as new equipment, and of e-class for communication with students.</p>																			
<p>TEACHING ORGANIZATION <i>The ways and methods of teaching are described in detail.</i> <i>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.</i> <i>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</i></p>	<table border="1"> <thead> <tr> <th><i>Activity</i></th> <th><i>Workload/semester</i></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td>39</td> </tr> <tr> <td>Laboratory exercises</td> <td>39</td> </tr> <tr> <td>Bibliographic research and analysis</td> <td>42</td> </tr> <tr> <td>Laboratory reports</td> <td>30</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td>TOTAL</td> <td>150</td> </tr> </tbody> </table>	<i>Activity</i>	<i>Workload/semester</i>	Lectures	39	Laboratory exercises	39	Bibliographic research and analysis	42	Laboratory reports	30							TOTAL	150	
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<p>STUDENT EVALUATION <i>Description of the evaluation process</i> <i>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</i> <i>Please indicate all relevant information about the course assessment and how students are informed</i></p>	<p>Essay development questions: 9% Problem Solving: 51% Laboratory reports: 40%</p>																			

5. SUGGESTED BIBLIOGRAPHY

Voudrias, E.A. (2018). "Hazardous waste technology and management", edition of Democritus University of Thrace

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Evangelos Voudrias and Ioannis Papaspyros (laboratory support)
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 laboratory reports, after each lab exercise is executed.
Implementation Instructions: (3)	<p>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.</p> <p>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.</p> <p>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.</p> <p>The evaluation method is the same with student evaluation in normal circumstances presented above.</p>

(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.