

COURSE OUTLINE

1. GENERAL

SCHOOL	FACULTY OF ENGINEERING		
DEPARTMENT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	Δ7ΥΠ	SEMESTER	2 ^ο
COURSE TITLE	ATMOSPHERIC CHEMISTRY		
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 (theory)	2		
Exercises/problems	1		
Laboratories	3		
Total	6	5	
<i>Please, add lines if necessary. Teaching methods and organization of the course are described in section 4.</i>			
COURSE TYPE <i>Background, General Knowledge, Scientific Area, Skill Development</i>	BACKGROUND		
PREREQUISITES:	MATHEMATICS		
TEACHING & EXAMINATION LANGUAGE:	GREEK ENGLISH FOR ERASMUS STUDENTS		
COURSE OFFERED TO ERASMUS STUDENTS:	YES		
COURSE URL:	https://eclass.duth.gr/courses/TMC101/ (Lectures) https://eclass.duth.gr/courses/TMC348/ (Labs)		

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.

The goal of this course is the familiarization of the students with the atmospheric chemistry and the chemical processes that take place in the atmosphere, as well as their education in atmospheric pollutants measurement techniques from chemical processes. After the completion of the course the students will be able to:

- understand the role of the basic atmospheric components
- understand the basic chemical reactions in the troposphere and the stratosphere
- understand the chemistry of the aqueous phase and the reactions that take place in the clouds
- evaluate atmospheric chemistry problems and suggest solutions
- simulate (using the corresponding tools) the chemical reactions under specific environmental conditions
- analyze data and solve problems that are caused by atmospheric chemical processes

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

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

3. COURSE CONTENT

1. Introduction in the atmosphere, concentration's units in the atmosphere, atmospheric composition (ozone, nitrogen oxides, carbon dioxide, carbon monoxide, methane, sulfur dioxide, organic compounds, halocarbons)
2. Chemistry of the troposphere, photochemical cycle of NO₂-NO-O₃, oxidation of methane, atmospheric chemistry of organic compounds (formaldehyde, alkanes, alkenes, aldehydes, ketones, alcohols, aromatic compounds)
3. Chemistry of the VOC/NO_x system, the role of VOCs and NO_x, ozone diagram, reactivity of organic compounds and their contribution to ozone formation, atmospheric chemical reactions of inorganic compounds
4. Atmospheric chemistry in the liquid phase, water in the atmosphere, equilibrium between gas and liquid phases and Henry's law
5. Chemical equilibrium in clouds: carbon dioxide and water, ammonia and water, nitric acid and water
6. Liquid phase reaction rates, oxidation of S(IV) to S(VI)
7. Stratospheric chemistry
8. Analytical methods of atmospheric chemistry study

Laboratory courses:

EXERCISE 1: Atmospheric ozone measurements

EXERCISE 2: Atmospheric nitrogen oxides measurements

EXERCISE 3: Kinetics of chemical reactions and ozone diagram construction

EXERCISE 4: Fraction of a compound in the liquid phase of a cloud as a function of Henry's Law constant and distribution of pollutants in cloud water as a function of pH

EXERCISE 5: Oxidation rate of S(IV) by H₂O₂ and by O₃

4. LEARNING & TEACHING METHODS - EVALUATION

<p>TEACHING METHOD</p> <p><i>Face to face, Distance learning, etc.</i></p>	Face to face	
<p>USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT)</p> <p><i>Use of ICT in Teaching, in Laboratory Education, in Communication with students</i></p>	Use of ICT in teaching and laboratory education, usage of board	
<p>TEACHING ORGANIZATION</p> <p><i>The ways and methods of teaching are described in detail.</i></p>	<p><i>Activity</i></p>	<p><i>Workload/semester</i></p>
	Lectures	40
	Exercises/problems	20

<p>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.</p> <p>The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards.</p>	Laboratory exercises	20
	Laboratory reports	30
	Bibliographic research and analysis	40
	Total	150
<p>STUDENT EVALUATION</p> <p>Description of the evaluation process</p> <p>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</p> <p>Please indicate all relevant information about the course assessment and how students are informed</p>	<p>Laboratory exercises (30%)</p> <p>Written exam, problem solving (70%)</p>	

5. SUGGESTED BIBLIOGRAPHY

1. «ΣΗΜΕΙΩΣΕΙΣ ΑΤΜΟΣΦΑΙΡΙΚΗΣ ΧΗΜΕΙΑΣ» Ευαγγελία Κωστανίδου, ΕΛΕΥΘΕΡΟ στο e- class.
2. «ΕΡΓΑΣΤΗΡΙΑΚΕΣ ΑΣΚΗΣΕΙΣ ΑΤΜΟΣΦΑΙΡΙΚΗΣ ΧΗΜΕΙΑΣ» Ευαγγελία Κωστανίδου, ΕΛΕΥΘΕΡΟ στο e- class.
3. «CHEMISTRY OF THE UPPER AND LOWER ATMOSPHERE» B. Finlayson- Pitts and J. Pitts J. Academic Press 2000.
4. «ATMOSPHERIC CHEMISTRY AND PHYSICS» J. Seinfeld, S. Pandis. Wiley Interscience, Second Edition 2006 (Στην βιβλιοθήκη του ΔΠΘ με αριθμό καταχώρησης QC 879.6.S45 2006).

ANNEX OF THE COURSE OUTLINE

Alternative ways of examining a course in emergency situations

Teacher (full name):	Evangelia Kostenidou
Contact details:	ekosteni@env.duth.gr
Supervisors: (1)	YES
Evaluation methods: (2)	Written examination with distance learning methods
Implementation Instructions: (3)	The exams will take place in zoom. All the students will be connected through their university account, otherwise they will not have access. During the examination the webcam and the microphone will be on. At the beginning of the examination each student will show their ID on the webcam for the verification of his/her identification. The examination will have a total duration of 3 hours. The exercises will be sent to the email account of each student, and they will be a combination of multiple-choice test and problem solving. The answers will be scanned (with a scanner or a camera) and they will be sent to an email account (that the professor will give in advance) before the end of the exams.

(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.