ΔΗΜΟΚΡΙΤΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΡΑΚΗΣ

ΤΜΗΜΑ ΜΗΧΑΝΙΚΩΝ ΠΕΡΙΒΑΛΛΟΝΤΟΣ

ΠΜΣ «ΠΕΡΙΒΑΛΛΟΝΤΙΚΗ ΜΗΧΑΝΙΚΗ ΚΑΙ ΕΠΙΣΤΗΜΗ»

Πανεπιστημιούπολη Κιμμερίων, Κιμμέρια – Ξάνθης 67100

Α6

Περιγράμματα μαθημάτων του ΠΜΣ «ΠΕΡΙΒΑΛΛΟΝΤΙΚΗ ΜΗΧΑΝΙΚΗ ΚΑΙ ΕΠΙΣΤΗΜΗ».

Ξάνθη, Δεκέμβριος 2022

ΠΕΡΙΕΧΟΜΕΝΑ

Α' ΕΞΑΜΗΝΟ

(α) 1η Ειδίκευση: Κλιματική αλλαγή, ανανεώσιμες πηγές ενέργειας και ενεργειακός σχεδιασμός κτηρίων και οικισμών

Β' ΕΞΑΜΗΝΟ

(β) 2η Ειδίκευση: Τεχνολογία και διαχείριση αποβλήτων

Β' ΕΞΑΜΗΝΟ

(γ) 3η Ειδίκευση: Νέες Τεχνολογίες στη Διαχείριση Υδατικών Πόρων

Β' ΕΞΑΜΗΝΟ

Γ' ΕΞΑΜΗΝΟ

Μεταπτυχιακή διατριβή

COURSE OUTLINE

1. GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Environmental Engineering		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE		SEMESTER	1º
COURSE TITLE	Control Engineering of Atmospheric Pollutants		

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
	3	7.5
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, skills development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Only if Greek speaking
COURSE WEBSITE (URL)	

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*

By successfully completing the course, the students will be able to know:

- the basic principles of antipollution technology of air pollutants and air pollution control technologies

- the most important parameters for the selection of the appropriate anti-pollution technology and the estimation of the pollutants' emissions
- the pollutants' removing mechanisms from the released gases using absorption, adsorption and combustion methods
- the methods of controlling Sulfur Oxides (SOx) and Nitrogen Oxides (NOx) emissions
- the design of SOx and NOx control devices

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas
- Respect for the natural environment
- Production of free, creative and inductive thinking
- Project planning and management

3. SYLLABUS

Course not offered in English. For course content refer to the available course outline in Greek.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching and communication with students
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* *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.*	The grade of the written exam at the end of the semester will also constitute the final evaluation score of the course. The written exam will include exercises and short-answer questions.

Activity	*Semester workload*
Lectures	13 (X3 hrs)
Study of bibliography – non-directed	50
Problem solving - directed	46
Problem solving – non-directed	40
Exam study	50
Course total	*225*

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *ΒΑΣΙΚΕΣ ΑΡΧΕΣ ΑΝΤΙΡΡΥΠΑΝΤΙΚΗΣ ΤΕΧΝΟΛΟΓΙΑΣ ΑΤΜΟΣΦΑΙΡΙΚΩΝ ΡΥΠΩΝ", Σ. Ραψομανίκης και Ε. Καστρινάκης, Εκδόσεις Τζιόλα 2009*
- *Schnelle Jr, Karl B., Russell F. Dunn, and Mary Ellen Ternes. Air pollution control technology handbook. CRC press, 2015.*

- Related academic journals:

- *Science*
- *Catalysts, MDPI*
- *Applied Catalysis B: Environmental, Elsevier*

COURSE OUTLINE

(1) GENERAL

SCHOOL	FACULTY OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	MASTER		
COURSE CODE		SEMESTER	1st
COURSE TITLE	WASTEWATER MANAGEMENT AND TREATMENT TECHNOLOGIES		

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
	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*	General background
PREREQUISITE COURSES:	Mathematics, Chemistry for Engineers, Fluid Mechanics, Environmental Microbiology, Physical and Biochemical Processes
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek/English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC206/

(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 aims to provide:

1. Cognitive

• Familiarity with Greek and European legislation regarding to wastewater treatment technologies

• Understanding the importance of physical and biochemical processes in wastewater treatment

• Understanding the basic design parameters of wastewater treatment units regarding secondary and tertiary treatment

• Design parameters application regarding design and dimensioning of treatment units

2. Skills

• Acquiring the ability to design and study wastewater treatment units

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
Working in an international environment
Working in an interdisciplinary environment
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
Production of free, creative and inductive thinking
……

Production of new research ideas	*Others…* *…….*

Expert knowledge of physical, chemical and biochemical process engineering
Expert knowledge of waste water treatment technologies
Specialized knowledge on construction of wastewater management and treatment facilities

(3) SYLLABUS

1. Directives concerning urban and industrial waste water treatment
2. Sources and characteristics of wastewater – Types of collection systems
3. Wastewater pretreatment - Removal of constituents, such as oil, grease, and various solids (e.g., sand, fibres and trash)
4. Wastewater pretreatment - Primary sedimentation - Design Exercises
5. Biological wastewater treatment processes - Design parameters - Oxidation of organic carbon compounds and ammonia (Nitrification)
6. Biological wastewater treatment processes - Nitrate reduction (Denitrification)
7. Biological wastewater treatment processes - Phosphorus removal
8. Design exercises of organic carbon compounds and nutrients removal.
9. Secondary Sedimentation - Design Exercises
10. Using of membrane bioreactors in the wastewater treatment
11. Biosolids management in wastewater treatment
12. Anaerobic sludge digestion
13. Design of an anaerobic sludge digestion unit

Presentation of student works

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching, communication with students
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* *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.*	Students' Learning and Performance is assessed by • Creating assignments of aerobic and anaerobic wastewater treatment plants design (30% of the final mark) • Creating bibliographic assignment and its presentation (20% of the final mark) • Final written or oral exams (50% of the final mark)

Activity	*Semester workload*
Lectures/ Theory	36
Design exercises	52
Literature study	85
Elaboration of individual work	47
Preparation and Presentation of the work	5
Total Course	225

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  1. Course of lectures available in e-class

2. Wastewater Engineering: Treatment and Resource Recovery 5th Edition

COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Environmental Engineering		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE		SEMESTER	1º
COURSE TITLE	SOLID AND HAZARDOUS WASTE MANAGEMENT AND TECHNOLOGY		

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
	3	7.5
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, skills development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/1424440/

(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*

By successfully completing the course, the students will be able to gain knowledge on:

- Greek and European solid waste legislation
- the basic principles of the management of solid, hazardous and special waste streams by an engineer
- the key elements that need to be measured and collected in order to design a municipal solid waste management system at the pre-study level
- the mechanisms governing the mechanical, biochemical and thermal treatment of solid waste

- the basic design elements of systems for the recovery of recyclable materials, composting and anaerobic digestion of bio-waste, thermal treatment of residues (waste fuel).
- the principles to design a waste landfill
- economic valuation methods of solid waste management systems
- methods to assess the environmental footprint of urban solid waste treatment and disposal technologies

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	……

- Research, analysis and synthesis of data and information, using the necessary technologies
- Design and management of projects related to solid waste management
- Acquiring knowledge so that they can proceed to further postgraduate and doctoral studies
- Demonstrate social, professional and ethical responsibility and sensitivity to gender issues
- Autonomous work
- Work in an international environment
- Work in an interdisciplinary environment
- Generation of new research ideas
- Protection and respect for public health and the environment
- Promotion of free, creative and inductive thinking

(3) SYLLABUS

1. Introduction and development in solid and hazardous waste management - definitions - European and Greek legislation
2. Production (sources, types and composition) of municipal solid waste and hazardous waste
3. Physical, chemical and biological characteristics of municipal solid waste and hazardous waste
4. Temporary storage, sorting and source separation – recycling
5. Collection of municipal solid waste and materials separated at source – transport and transfer stations
6. Size reduction, separation of municipal solid waste and recovery of materials
7. Mechanical sorting and processing facilities – mass balances
8. Composting
9. Anaerobic treatment
10. Biological drying – the concept of mechanical-biological treatment (MBT)
11. Thermal treatment technologies
12. Sanitary landfilling
13. Strategies for selecting technologies

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching and communication with students
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*	*Activity* / *Semester workload* Lectures — 13 X2 ώρες = 26 Study of bibliography – non-directed — 50 Problem solving - directed — 55 Problem solving – non-directed — 44 Study for exams — 50 Course total — *225 hours*
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	3-5 short assignments during, and at the end of, the semester, either individually or in groups (70% grade weight) Final oral (remote) exam per student (30%).

(5) ATTACHED BIBLIOGRAPHY

Slides, texts and design sheets (in electronic format) that will be made available to the students via eclass.

Material from internet

Recommended books (in Greek):

Κομίλης, Δ., 2021. Διαχείριση και Μηχανική Στερεών Αποβλήτων. Εκδόσεις Τζιόλας, Θεσσαλονίκη (2η εκδ).

Γιδαράκος, Ε., Αϊβαλιώτη, Μ. 2021. Επικίνδυνα Απόβλητα: Διαχείριση, Επεξεργασία, Διάθεση, ΕΑΔΠΚ, Πολυτεχνείο Κρήτης, Χανιά (2η εκδ.)

COURSE OUTLINE

1. GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	POSTGRADUATE STUDY PROGRAM I		
COURSE CODE		SEMESTER	1st
COURSE TITLE	ECOLOGICAL ENGINEERING AND TECHNOLOGY - ECOHYDROLOGY		

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
	3	7.5
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 SPECIALISED
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/1424433/

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*

Knowledge-based

- Student introduction to the ecological engineering processes.
- Comprehending the processes of pollutants production in urban runoff.
- Understanding the functions of best management practices (BMP) of urban runoff.
- Understanding the function and physicochemical processes of stabilization ponds on wastewater treatment.
- Understanding the function and physicochemical processes of constructed wetlands on wastewater treatment.
- Understanding the physicochemical processes taking place in aquatic systems.
- Understanding the principles and applications of ecohydrology

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, Project planning and management

with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*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* *Production of free, creative and inductive thinking* *……* *Others…* *……*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Working in an interdisciplinary environment
- Project planning and management
- Respect for the natural environment

3. SYLLABUS

1. The science of Ecological Engineering: Introduction, definitions.
2. Pollutants and pollution from urban runoff. Production processes, type and sources of urban runoff pollutants.
3. Best Management Practices (BMPs) to control the urban runoff pollution.
4. Rapid infiltration and slow rate land systems for wastewater treatment.
5. Natural wastewater treatment systems. Facultative ponds: Description, design, function, efficiency on pollutant removal.
6. Anaerobic and maturation ponds: Description and design, efficiency on pollutant removal.
7. Constructed wetland (CW) systems for wastewater treatment.
8. Pilot-scale and large-scale CWs applications in wastewater treatment. Environmental footprint of constructed wetlands.
9. Models for removal of organic matter, suspended solids, nitrogen, phosphorus and pathogenic microorganisms.
10. Sources of aquatic systems pollution (description, distinction).
11. Mathematical models of surface water quality (SWAT, WASP, QUAL2E).
12. Use of mathematical models for watershed and transboundary basin management.
13. General principles and applications of ecohydrology in river and coastal systems

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching and communication with students.
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*	*Activity* / *Semester workload* Lectures: 40 Exercises: 30 Bibliographic research & analysis: 80 Individual semester Project: 65 Project presentation: *10* Course total: ***225***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	Assessment Language: Greek Short Answer Questions and Problem Solving (final written exam) 50% Semester project (individual) 50%

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Ecological Engineering and Technology, Vol. I: Management of runoff, pollutant and sediments", Vassilios A. Tsihrintzis, University Press Book (In Greek).
2. Tsihrintzis V.A.., «Ecological Engineering and Technology, Volume 2: Natural Methods for Wastewater Treatment», Edition DUTH (In Greek).
3. Antonopoulos, V. Z. 2010. «Environmental Hydraulics and Surface Water Quality», Eds. A. TZIOLA (in Greek)
4. Novotny V., and Olem H., (1994), «Water Quality – prevention, Identification, and management of Diffuse Pollution», Van Nostrand Reinhold, New York, USA.
5. Kadlec, R. H. and Wallace, S. D., «Treatment Wetlands», 2nd Edition, Taylor and Francis Group, Boca Raton, USA. ISBN 978-1-56670-526-4.
6. Reed S.C., Crites R.W., and Middlebrooks E.J., (1995), «Natural Systems for Waste management and Treatment», 2nd Edition, McGrow-Hill, Inc., New York, USA.
7. Chapra S.C., 1997, «Surface Water – Quality Modeling». McGraw-Hill Book Company, New York.

- Related academic journals:

1. Ecological Engineering
2. Journal of hydrology

COURSE OUTLINE

(1) GENERAL

SCHOOL	of ENGINEERING		
ACADEMIC UNIT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	POSTGRADUATE STUDIES		
COURSE CODE	TMC200	SEMESTER	1st
COURSE TITLE	ENERGY IN BUILDINGS - RENEWABLE ENERGY SOURCES (RES) AND APPLICATIONS AT BUILDINGS AND SETTLEMENTS		

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
	3hrs	7,5
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*	General background Skills development
PREREQUISITE COURSES:	Mathematics, Heat Transfer, Fluid-mechanics, Atmospheric Physics
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (Lectures, Examination)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	https://eclass.duth.gr/modules/course_info/?course=TMC200

(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 aims at:

- Familiarization of students with the energy behaviour and energy design of buildings' issues as well as understating of their energy and thermal balance and the parameters that affect them
- Understanding of the main principles and systems of energy design of a building
- Familiarization of RES application at the built environment, both at buildings and settlements towards carbon neutral buildings and settlements
- Knowledge of human thermal comfort issues
- Obtaining knowledge in order to propose optimum energy solutions for buildings and settlements for energy savings and RES application aiming at zero energy consumption

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, *Project planning and management*

with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*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* *Production of free, creative and inductive thinking* *……* *Others…* *……*

- Search for, analysis and synthesis of data and information with the use of the necessary technology
- Apply knowledge in practice
- Decision-making
- Working independently
- Production of new research ideas
- Respect for the natural environment
- Production of free, creative and inductive thinking

(3) SYLLABUS

- Introduction at energy issues: energy balance, main RES sources, basic RES theory principles (solar geometry, potential, etc)
- Passive solar systems
- Natural ventilation of buildings
- Solar systems (Solar thermal, photovoltaics)
- Biomass – Geothermic energy – District heating / cooling of building complexes and settlements
- Urban wind energy systems - Small hydroelectric plants
- Alternative energy sources (hydrogen, wave energy, cogeneration systems, etc)
- Natural daylight – Control/regulation of lighting systems – Energy conservation at lighting systems
- RES applications at settlements – Examples
- Energy autonomous buildings and settlements – Examples
- RES application issues at buildings and settlements: European and national legislation, application obstacles, economical assessment, etc.)
- Presentation of semester students' projects

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching, communication with students
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* *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.*	The evaluation procedure is based on synthesis of essays / calculation exercises and presentation / oral examination on them. The allocation of marks is : • Intermediate Essays /Exercises : 20% (1st Essay) + 15% (1st Calculation exercise) + 15% (2nd Calculation Exercise) • Semester Essay: 50% A prerequisite is to get a grade of 5.0 at each examination. The evaluation criteria are accessible to students in course e-class site.

Activity	*Semester workload*
Lectures	39
Study and analysis of bibliography	80
Essay /Exercises synthesis	60
Essay /Exercise writing	36
Essay / Exercise presentation	10
Course total	*225*

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Kosmopoulos P., Perivolaris A., Environmental design: Zero energy buildings, University Studio Press, Thessaloniki, 2017 (in Greek).
- Xronaki E., Bioclimatic design: Climate change, Environment and Sustainability (2nd edition), University Studio Press, Thessaloniki, 2017 (in Greek).
- Papadopoulos M., Axarli Kl., Energy design and passive solar systems for buildings, Kyriakidis Publications IKE (in Greek)
- Lecture presentations uploaded at course e-class site
- Several free access textbooks uploaded at course e-class site

- Related academic journals:

Energy & Buildings, Energy Procedia, Energy & Built Environment, Procedia environmental sciences, Renewable & Sustainable Energy Reviews, Energy efficiency & buildings, Energy policy, Energy Conversion & Management, Solar energy

COURSE OUTLINE

(1) GENERAL

SCHOOL	Polytechnic School, DUTH		
ACADEMIC UNIT	Environmental Engineering		
LEVEL OF STUDIES	7		
COURSE CODE		SEMESTER	1st
COURSE TITLE	Circular Economy and Green Entrepreneurship		

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
	3	7,5
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*	General background
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC374/

(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 Circular Economy and Green Entrepreneurship course aims to provide students with the fundamentals of circular economy, entrepreneurship, entrepreneurship and environmental management. The aim of the course is to get familiar with the applications that the use of entrepreneurship and the circular economy can offer in solving environmental problems. After successful completion of the course, the student will have:

• understand the importance of the basic concepts of entrepreneurship,

• understand the functioning mechanisms of the economy and society,

- understand circular economy mechanisms at a micro level
- understanding circular economy mechanisms at a macro level
- understanding of circular economy mechanisms at a medium-level
- understand how to find new business opportunities.
- become familiar with the concepts of green entrepreneurship.
- become familiar with writing a business plan.
- understand financial analysis techniques for green entrepreneurship.
- acquire the ability to prepare business plans for green business ideas.

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

- Search, analysis and synthesis of data and information, using the necessary technologies
- Decision making
- Teamwork
- Generation of new research ideas
- Generation of new research ideas
- Respect for the natural environment
- Promotion of free, creative and inductive thinking

(3) SYLLABUS

1) Circular Economy – Introductory Concepts
2) Circular Economy – The entrepreneurial side
3) Circular Economy – The Demand Side
4) Entrepreneurship – Innovation
5) Green Entrepreneurship – Introductory Concepts
6) Analysis of Types of Green Entrepreneurship
7) Business Plan and Green Entrepreneurship
8) SWOT Analysis, PEST analysis and Green Entrepreneurship
9) Economic Analysis of Green Entrepreneurship
10) Analysis of Green Entrepreneurship Business Plans
11) Investment evaluation
12) Cost benefit analysis
13) Multi-criteria investment analysis

(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*	The ICT are an integral part of the course
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* *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.*	The course is evaluated: With six-monthly work.

Activity	*Semester workload*
Lectures	40
Seminars	30
Literature study and analysis	40
Create material folder	40
Course total	*150*

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Βιβλίο [50662617]: ΟΙΚΟΝΟΜΙΚΗ ΦΥΣΙΚΩΝ ΠΟΡΩΝ ΚΑΙ ΠΕΡΙΒΑΛΛΟΝΤΟΣ, ΧΑΛΚΟΣ ΕΜΜ. ΓΕΩΡΓΙΟΣ
2. Βιβλίο [22714756]: Από την κρίση στη βιώσιμη ανάπτξη, Μπαμπανάσης Σ.
3. Βιβλίο [59397350]: Επιχειρηματικότητα και μικρές Επιχειρήσεις 2η Έκδοση, David Deakins, Mark Freel

- Related academic journals:

Journal of Cleaner Production
Circular Economy and Sustainability

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE		SEMESTER	WINTER
COURSE TITLE	GEOGRAPHIC INFORMATION SYSTEMS		

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
	3	7.5
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, skill development
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC372/

(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*

Understanding the GIS principles
GIS applications in a wide range of environmental applications
Skill development for complex problem solving
Familiarization with processing of multi-source data
Skill development for use of open GIS software, i.e. Qgis
Communication of project results

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

Search for, analysis and synthesis of data and information with the use of the necessary technology
Decision-making
Working independently
Team work
Working in an interdisciplinary environment
Production of new research ideas
Production of free, creative and inductive thinking
Team

(3) SYLLABUS

1. *Introduction to GIS, design of geospatial databases*
2. *Interoperability among different platforms, open data sources, Google Earth Engine, Open Street Map, Inspire geoportal.*
3. *Spatial statistics*
4. *DEM based analysis, slope, aspect, visibility analysis*
5. *Siting problems*
6. *Determination of protection zones*
7. *GIS and remote sensing, Terra and Aqua datasets*
8. *Spatiotemporal analysis of vegetation index datasets*
9. *Spatiotemporal analysis of LST*
10. *The GRACE mission – analysis of gravity measurements*
11. *Use of GRACE datasets to determine ice sheet losses*
12. *Combining of model and remotely sensed datasets*
13. *Presentation of case studies*

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	*Distant learning with Power Point presentations. All presentations available with additional study material and assignments via e.class platform*
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	*ICT is used throughout the course activities in teaching, laboratory exercises and communication. The course is strongly oriented to the use and application of open source software and open data analysis.*
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*	

Activity	***Workload/semester***
Lectures – face to face	26
Exercises - supervised	19
Bibliographic research - unsupervised	50
Problem solving - unsupervised	50
Project development - supervised	40
Presentation preparation - unsupervised	40
Total	225

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	*Student performance evaluation is achieved with a project assignment and presentation of results publicly. Students are asked to respond to five questions related to their assignment. The final grade is based on the presentation and the ability of the student to answer related questions.*

(5) ATTACHED BIBLIOGRAPHY

-Bibliography:
QGIS and Applications in Water and Risks [electronic resource]
Κωδικός Βιβλίου στον Εύδοξο: 91722929
Αριθμός τόμου:
Έκδοση: 1st ed./2018
Συγγραφείς: Baghdadi
ISBN: 9781119476726
Τύπος: Ηλεκτρονικό Βιβλίο
Διαθέτης (Εκδότης): HEAL-Link Wiley UBCM ebooks

QGIS and Applications in Territorial Planning [electronic resource]
Κωδικός Βιβλίου στον Εύδοξο: 91722928
Αριθμός τόμου:
Έκδοση: 1st ed./2018
Συγγραφείς: Baghdadi
ISBN: 9781119457121

Τύπος: Ηλεκτρονικό Βιβλίο
Διαθέτης (Εκδότης): HEAL-Link Wiley UBCM ebooks

QGIS and Applications in Agriculture and Forest [electronic resource]
Κωδικός Βιβλίου στον Εύδοξο: 91722927
Αριθμός τόμου:
Έκδοση: 1st ed./2018
Συγγραφείς: Baghdadi
ISBN: 9781119457107
Τύπος: Ηλεκτρονικό Βιβλίο
Διαθέτης (Εκδότης): HEAL-Link Wiley UBCM ebooks

GDAL-SOFTWARE-SUITE. Geospatial data abstraction library. https://gdal.org, 2013.

GRASS-PROJECT. Geographic resource analysis support system. https://grass.osgeo.org, 2013.

NETELER, M., AND MITASOVA, H. Open source gis: A grass gis approach, 2008.

OGR-SOFTWARE-SUITE. Geospatial data abstraction library. https://gdal.org, 2013.

OPEN-GEOSPATIAL-CONSORTIUM. Web map service (1.1.1) implementation specification. https://portal.opengeospatial.org, 2002.

OPEN-GEOSPATIAL-CONSORTIUM. Web map service (1.3.0) implementation specification. https://portal.opengeospatial.org, 2004.

POSTGIS-PROJECT. Spatial support for postgresql. http://postgis.refractions.net/, 2013.

- Συναφή επιστημονικά περιοδικά:
GIScience and Remote Sensing,
Geoinformatics,
Transactions in GIS,
Cartography and Geographic Information Science,
Geocarto International

COURSE OUTLINE

(1) GENERAL

SCHOOL	Faculty of Engineering		
ACADEMIC UNIT	Environmental Engineering		
LEVEL OF STUDIES	7		
COURSE CODE		SEMESTER	1st
COURSE TITLE	Environmental Chemistry		
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

	3	7.5
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, Specialised general knowledge
PREREQUISITE COURSES:	NO
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://pmemaster.env.duth.gr/περιβαλλοντική-χημεία/

(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 aim of the course is the introduction of students to environmental chemistry and to develop students' awareness of the role of chemistry in the science of environmental engineering. Upon successful completion of the course students will have received basic and specialized knowledge of chemistry related to environmental science and engineering and:

- will be able to use their knowledge and skills to solve complex issues within an interdisciplinary field
- will have the ability to combine knowledge and handle multidimensional issues in environmental engineering issues
- will be able to communicate their results and their knowledge
- will possess specialized knowledge and acquire skills on cutting edge fields in the science of environmental engineering
- will possess specialized skills through the application of knowledge and know-how to solve complex problems on research and to develop new knowledge
- will develop critical thinking and critical awareness of environmental chemistry and chemical technology with applications to environmental issues as well as their interconnection with other fields
- will acquire data analysis skills in the field of aqueous and analytical chemistry in systems of environmental interest

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…* *…….*

The course offers the following theoretical and practical skills:

- Theoretical thinking and ability to transform theory into practice
- Ability to apply knowledge to solve problems in aqueous and analytical chemistry and environmental chemistry in general
- Work in an interdisciplinary environment
- Ability to search, analyze and synthesize data and information using the necessary technologies and make decisions
- Generation of new research ideas
- Promotion of free, creative and inductive thinking
- Understand the principles of chemical processes and apply them to environmental technology
- Autonomous Work
- Research

(3) SYLLABUS

1. Environmental Chemistry – Introduction
2. Hydrosphere: Chemistry of the hydrosphere
3. Quantum theory of the atom, electronic structures and bonds
4. Chemical Reactions - Reaction Rate - Chemical Equilibrium
5. Acids and Bases - Acid-Base Equilibria
6. Activity and ionic strength – Salts, Solubility, Solubility Product
7. Thermodynamics and Equilibrium: 1st, 2nd and 3rd laws of thermodynamics
8. Environmental samples. Solutions: Concentration of solutions – Expressions - Calculations. General methods of qualitative and quantitative analysis
9. Sampling – sample processing
10. Volumetric method: Neutralization – Precipitation – Complexation – Oxidation reduction
11. Use of materials for the treatment of pollutants – Adsorption
12. Use of materials for the treatment of pollutants – Catalysis
13. Presentation of assignments – Oral examination

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching and in communication with students
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*	

Activity	*Semester workload*
Lectures	39
Asynchronous learning	8
Study	65
Analysis of bibliography	54
Essay writing	59

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*		
	Course total	***225***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	Language of evaluation: Greek Written work/essay and public presentation	

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
Βασικές αρχές ανόργανης χημείας (Basic principles of inorganic chemistry)

- Related academic journals:
Applied Catalysis B: Environmental
Chemosphere
Environmental Science and Technology
International Journal of Environmental Analytic Chemistry

COURSE FRAME

(1) ΓΕΝΙΚΑ

SCHOOL	SCHOOL of ENGINEERING		
DEPARTMENT	ENVIRONMENTAL ENGINEERING		
ΕΠΙΠΕΔΟ ΣΠΟΥΔΩΝ	Post-graduate		
COURSE CODE	TMC378	**SEMESTER**	2ο
COURSE TITLE	Technologies of Renewable Energy Sources		
INDIPENTENT TEACHING ACTIVITIES		**Lecture hours per week**	**ECTS**
		3	7,5
COURSE TYPE	Special background, Specialization, Capabilities development		
PREREQUISITE COURSES:	-		
TEACHING AND EXAMS LANGUAGE:	GREEK		
OFFER TO ERASMUS STUDENTS	-		

COURSE URL	https://eclass.duth.gr/courses/TMC378/

(2) LEARNING OUTCOMES

Learning outcomes
The course aims to introduce students to the basic principles and calculations of a number of renewable energy technologies. After its successful completion, students will have comprehended: • Energy balances, global warming issues, fossil fuel reserves depletion, the role and the prospects of renewable energy sources • Solar radiation yearly/hourly variations and photovoltaics power generation • Wind speed distributions, and wind turbines operation • Composition and biomass properties, biomass cogeneration technologies • Hydrogen production and conversion technologies and obtained the capabilities: • to calculate solar radiation and its quantitative conversion to power, by photovoltaics of variable inclination • to calculate the wind-turbines power generation by variable wind speeds • to design, and calculate the power generation of autonomous, hybrid photovoltaics/wind-turbines systems • to calculate the power output and the efficiency of biomass cogeneration processes • to calculate the power input/output and the efficiency of electrolysis units and fuel cells
General Capabilities
Research, analyze and compose data and information, by the use of appropriate technologies. Independent work. Operation in a multi-scientific environment. Promote creative and inductive thought.

(3) COURSE INDEX

1. Introduction
2. Thermal Engines
3. Biomass and Biofuels
4. Cogeneration through biomass combustion and gasification
5. Biogas cogeneration
6. Electrolysis
7. Fuel Cells
8. Photovoltaic Systems
9. Wind-turbines Systems
10. Energy storage systems
11. Design of RES systems I
12. Design of RES systems II

13. Design of RES systems III

(4) ΔΙΔΑΚΤΙΚΕΣ και ΜΑΘΗΣΙΑΚΕΣ ΜΕΘΟΔΟΙ - ΑΞΙΟΛΟΓΗΣΗ

LECTURES	In-class and distant.
USE of INFORMATION and COMMUNICATION TECHNOLOGIES	Calculation spreadsheets (excel), Teleconference platforms (MS-TEAMS).
TEACHING ORGANIZATION	
STUDENTS EVALUATION	Problems solving, elaboration of calculating case-studies.

Activity	*Semester work-load (hr)*
Lectures	39
Study elaboration	180
Course total	***219***

(5) SUGGESTED LITERATURE

- Suggested Literature:

(1) Κιοσκερίδης Ιορδάνης, **Ανανεώσιμες Πηγές Ενέργειας**
(2) Gilbert M. Masters, **Συστήματα παραγωγής ηλεκτρικής ισχύος από ανανεώσιμες πηγές ενέργειας**
(3) Κάρναβος Ν. - Λάππας Α. - Μαρνέλλος Γ., **Βιοκαύσιμα-Αειφόρος Ενέργεια**
(4) Vegiroglu Negat T., Smith Debbi, Bockris J. O'M., **Παραγωγή υδρογόνου από ηλιακή ενέργεια**

- Relevant Journals:

Journal of Power Sources
(**https://www.journals.elsevier.com/journal-of-power-sources/**)
Journal of Energy Storage
(https://www.journals.elsevier.com/journal-of-energy-storage)
Energy
(https://www.journals.elsevier.com/energy)
Renewable Energy
(**https://www.journals.elsevier.com/renewable-energy**)
Sustainable Energy Technologies and Assessments
(https://www.journals.elsevier.com/sustainable-energy-technologies-and-assessments)

Energy and Buildings
(**https://www.journals.elsevier.com/energy-and-buildings**)
International Journal of Hydrogen Energy
(**https://www.sciencedirect.com/journal/international-journal-of-hydrogen-energy**)
Energy for Sustainable Development
(https://www.journals.elsevier.com/energy-for-sustainable-development)
Sustainable Energy, Grids and Networks
(https://www.sciencedirect.com/journal/sustainable-energy-grids-and-networks/vol/21/suppl/C)

COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Environmental Engineering		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE		SEMESTER	2º
COURSE TITLE	Dispersion simulations of air pollutants		

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
	3	7.5
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, skills development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Only if Greek speaking
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/1424436/

(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*

By successfully completing the course, the students will be able to know:

- the basic principles governing the dispersion of pollutants in the atmosphere

- the types and operating principles of atmospheric dispersion models
- the parameterization and execution of advanced atmospheric dispersion models to study the dispersion of pollutants in the atmosphere, on a local and transboundary scale

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas
- Respect for the natural environment
- Production of free, creative and inductive thinking
- Project planning and management

(3) SYLLABUS

Course not offered in English. For course content refer to the available course outline in Greek.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching and communication with students
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* *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.*	A written assignment that students will present in class at the end of the semester will be used to evaluate their performance.

Activity	*Semester workload*
Lectures	13 (X3 hrs)
Study of bibliography – non-directed	50
Problem solving - directed	46
Problem solving – non-directed	40
Essay writing	50
Course total	***225***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *«Πηγές, Διασπορά και Έλεγχος Ατμοσφαιρικής Ρύπανσης» Μπεργελές Γ., Πανεπιστημιακές Εκδόσεις Ε.Μ.Π. 2010*

- Related academic journals:

- *Atmospheric Research, Elsevier*
- *Atmospheric Chemistry and Physics, Elsevier*
- *Atmosphere, MDPI*
- *Geoscientific Model Development, Copernicus*
- *Journal of Advances in Modeling Earth Systems, Wiley*

COURSE OUTLINE

1. GENERAL

SCHOOL	Engineering
ACADEMIC UNIT	Environmental Engineering
LEVEL OF STUDIES	Postgraduate

COURSE CODE		SEMESTER	Spring
COURSE TITLE	Climate change impacts, vulnerability and adaptation		

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
	3	7.5
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*	*Specialised general knowledge, skill development*
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC294/

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*

Understanding the climate change impacts on natural and human systems
Skill development for determination of risk factors related to vulnerability to climate change
Land cover change assessment skills
Determination of climate change impacts on water, soil and air
Skill development for analysis of impacts on cities and infrastructures
Skill development for the design of mitigation and adaptation measures

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
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

Team work *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Criticism and self-criticism* *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
Team work
Working in an interdisciplinary environment
Production of new research ideas
Production of free, creative and inductive thinking
Respect for the natural environment

3. SYLLABUS

1. Climate change and human induced changes
2. Quantification of global changes – expected changes
3. The 5 Shared Socioeconomic Pathways
4. Ice sheet changes
5. Sea level rise assessment – impacts on coastal land – flood surges
6. Land cover change assessment – vegetation carbon stocks
7. Carbon fluxes – carbon footprint
8. Bioclimatic variables
9. Risk management as a means of adaptation
10. Promotion of sustainable ecosystem functions
11. The role of technology on climate change mitigation and adaptation
12. Vulnerability of natural and human systems to climate change
13. Mitigation and adaptation measures

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	*Distant learning with Power Point presentations. All presentations available with additional study material and assignments via e.class platform*
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	*ICT is used throughout the course activities in teaching, laboratory exercises and communication. The course is strongly oriented to the*

Use of ICT in teaching, laboratory education, communication with students	*use and application of open source software and open data analysis.*

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

Activity	***Workload/semester***
Lectures – face to face	26
Exercises - supervised	19
Bibliographic research - unsupervised	50
Problem solving - unsupervised	50
Project development - supervised	40
Presentation preparation - unsupervised	40
Total	225

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

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.

Student performance evaluation is achieved with a project assignment and presentation of results publicly. Students are asked to respond to five questions related to their assignment. The final grade is based on the presentation and the ability of the student to answer related questions.

5. ATTACHED BIBLIOGRAPHY

- Βιβλιογραφία

- *Chen, Chi, Taejin Park, Xuhui Wang, Shilong Piao, Baodong Xu, Rajiv K Chaturvedi, Richard Fuchs, et al. 2019. "China and India Lead in Greening of the World through Land-Use Management." Nature Sustainability 2 (2): 122–29. https://doi.org/10.1038/s41893-019-0220-7.*
- *European Environment Agency. 2020. "The European Environment - State and Outlook 2020," 496. https://doi.org/10.2800/48006.*
- *IPCC. 2019. Foreword Technical and Preface. Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems.*
- *Mchenry, Mark P., Surendra N. Kulshreshtha, and Silvia Lac. 2015. "Land Use, Land-Use Change and Forestry." Land Use, Land-Use Change and Forestry. https://doi.org/10.4337/9781849805834.00023.*
- *IPCC. 2021. "Summary for Policymakers." IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Vol. 9781107025. https://doi.org/10.1017/CBO9781139177245.003.*

- Συναφή επιστημονικά περιοδικά:

Science of the Total Environment
Nature
Nature Sustainability
Climatic Change
Global Environmental Change

COURSE OUTLINE

(1) GENERAL

SCHOOL	of ENGINEERING		
ACADEMIC UNIT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	POSTGRADUATE STUDIES		
COURSE CODE	TMC255	SEMESTER	2nd
COURSE TITLE	ENERGY ASSESSMENT OF BUILDINGS - SIMULATION		

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
	3hrs	7,5
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*	Specialized general knowledge Skills development
PREREQUISITE COURSES:	Mathematics, Heat Transfer, Energy & Buildings – RES in building and settlements
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (Lectures, Examination)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC255/

(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 aims at:

- Familiarization with the Greek and European energy legislation for buildings
- Comprehension of the main principles of energy assessment calculations
- Familiarization with elaboration of an energy assessment report
- Familiarization with elaboration of an energy audit at buildings and systems
- Learning the application of an energy certification tool

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
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

Team work *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information with the use of the necessary technology
- Apply knowledge in practice
- Decision-making
- Working independently
- Production of new research ideas
- Respect for the natural environment
- Production of free, creative and inductive thinking

(3) SYLLABUS

- Basic principles of heat transfer at buildings (Thermal properties, thermal storage,heat losses from the envelope, convection, radiation)
- Basic principles and theory of thermal simulation - (European standards (EN))
- Energy simulation – Energy certification of buildings – Basic principles
- Methodology of thermal insulation calculations
- Description – Requirements of energy study
- Basic principles and procedure of energy audits of buildings
- Presentation of basic principles of energy study and energy audit models
- Demonstration of energy study and energy audit models
- Application of energy certification model - Semester project
- Presentation/ Examination of semester students' projects

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching, communication with students
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*	

Activity	*Semester workload*
Lectures	39
Study and analysis of bibliography	40
Essay /Project synthesis	60
Essay /Project writing	36
Essay / Project presentation	50
Course total	*225*

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	The evaluation procedure is based on synthesis of essays / calculation exercises and presentation / oral examination on them. The allocation of marks is : • Intermediate Essays: 30% (in subjects presented during lectures) • Semester Project: 70% (Application of certification software tool 'TEE-KENAK' at a building) A prerequisite is to get a grade of 5.0 at each examination. The evaluation criteria are accessible to students in course e-class site.

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Teachers' notebooks (uploaded at course website)
- Guide for Energy Audit of Buildings. 2011., MINENV
- Guide of techniques and instruments for energy measurements, CRES
- Technical Guides of the Technical Chamber of Greece (TOTEE)

- *Related academic journals:*

COURSE OUTLINE

(1) GENERAL

SCHOOL	of ENGINEERING		
ACADEMIC UNIT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	POSTGRADUATE STUDIES		
COURSE CODE	TMC193	SEMESTER	2nd
COURSE TITLE	ENVIRONMENTAL ASSESSMENT OF STRUCTURES – ENVIRONMENTAL FRIENDLY MATERIALS		

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
	3hrs	7,5

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*	Specialized general knowledge Skills development	
PREREQUISITE COURSES:	Energy and buildings – RES in buildings and settlements	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (Lectures, Examination)	
IS THE COURSE OFFERED TO ERASMUS STUDENTS		
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC193/	

(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 aims at:

- Comprehension of the environmental implications of structures
- Introduction at the basic principles of environmental management of structural elements and buildings
- Introduction at methods / models of environmental assessment of materials / structures / settlements

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

- Search for, analysis and synthesis of data and information with the use of the necessary technology
- Apply knowledge in practice

- Decision-making
- Working independently
- Production of new research ideas
- Design and management of projects (with environmental criteria)
- Respect for the natural environment
- Production of free, creative and inductive thinking

(3) SYLLABUS

The curriculum covers the following sections:

1. Main principles of circular economy in structures
2. Environmental implications from construction activity – Structural waste
3. Characteristics of environmental friendly construction materials and techniques
4. Recycling – Reuse of structural components / materials,
5. Eco-labeling
6. Life cycle analysis of structural components
7. European/International legislation for environmental assessment of buildings
8. Environmental assessment methods / tools for construction elements and materials
9. Examples of application of methods/tools of environmental assessment
10. Presentation of students' intermediate and semester assignments

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching, communication with students
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*	

Activity	*Semester workload*
Lectures	39
Study and analysis of bibliography	80
Essay /Exercises synthesis	60
Essay /Exercise writing	36
Essay / Exercise presentation	10
Course total	***225***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	The evaluation procedure is based on synthesis of essays and presentation / oral examination on them. The allocation of marks is : • Intermediate Essays: 50% • Semester Essay: 50% A prerequisite is to get a grade of 5.0 at each examination. The evaluation criteria are accessible to students in course e-class site.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Dimoudi A. (2013). 'Environmental Friendly Materials'. Xanthi: D.U.Th. (In Greek)
- Lecture presentations uploaded at course e-class site
- Several free access textbooks, papers uploaded at course e-class site
- ROAF S., FUENTES M., THOMAS St. (2017). ECODOMEIN, 2nd Ed., PSICHALOS F. & SIA Publ O.E. (In Greek)
- Technical Directive TEE, 20701-2/2017, «Thermophysical properties of structural materials and evaluation of buildings' thermal insulation» (In Greek)

- Related academic journals:

Building & Environment, Resources, Conservation & Recycling, Waste Management, Waste Management & Research, Ecological Indicators, Environmental Impact Assessment review, Building Research & Information, Journal of Cleaner Production

COURSE OUTLINE

1. GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Environmental Engineering		
LEVEL OF STUDIES	Post Graduate		
COURSE CODE		SEMESTER	Spring
COURSE TITLE	Energy and Environmental Design of Buildings - Simulation		
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		1,5	6,0
Assignment Support-Q&A sessions-powerpoint presentation		1	1,0
Software training		0,5	0,5
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*	On line		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek or/and English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC393/		

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*
• Knowledge of building physical phenomena. Natural lighting – sound protection • Knowledge of heat and moisture context in buildings

- Knowledge of the interior climate formation and urban microclimate
- Acquire skills in assessing methodologies of built environment and simulation techniques and tools
- Knowledge of building physics equipment, building energy and renewable technologies
- Data acquirement and analysis

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Develop skills in implementing assessment campaign of building and simulation
- Research ideas development
- Decision making
- Improve individual skills
- Team working
- Develop skills in analysing the acquired data
- Promotion of environmentally friendly behaviour

3. SYLLABUS

1. Heat and mass transfer in buildings. Conductivity-convection-radiation and comfort formation. Building interaction with environment
2. Building envelope energy behavior and human comfort
3. Simulation of buildings and settlements
4. Heating-cooling loads. Air conditioning
5. Condensation – interstitial condensation – estimation of wall temperature profiles
6. Visual comfort – natural and artificial
7. Light calculations and simulation – Equipment
8. Sound comfort – sound transmission and noise protection/reduction
9. Multi scale simulation modelling of built environment
10. Building renewable energy technologies and low carbon strategic planning
11. Experimental instrumentation, applications and simulation tools

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distant - On line
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Extended use and implementation of ICT tools
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*	

Activity	*Semester workload*
Distant lecture delivery-training-Q&A sessions-discussions	39 hrs
Assignment workout, improve software usage skills- powerpoint presentation delivery	186 hrs
Course total	*225*

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	Post graduate student assessment is assignment based with presentation in building energy & environmental performance topics that are delivered during lectures

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. McMullan, R.'Environmental science in building' (7th ed.) Palgrave (2012).
2. Riley M. & Howard C. 'Construction Technology 1' Palgrave (2002).
3. Egan, M. David. 'Architectural acoustics' McGraw Hill (2007).
4. Bean R. 'Lighting ' Architectural Press (2004).

5. http://www.auto-decibel-db.com/

- Related academic journals:

Energy and Buildings
Building and Environment
Renewable Energy
Energy
Sustainable Cities and Societies

COURSE OUTLINE

1. GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Environmental Engineering		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE		SEMESTER	2ο
COURSE TITLE	ADVANCED TOPICS IN SOLID AND HAZARDOUS WASTE MANAGEMENT		

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
	2	7.5
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*	Scientific background, skills development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC388/

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*

By successfully completing the course, the students will be able to:

- Calculate the environmental footprint of a solid waste management process,
- Apply the basic principles for implementing a life cycle analysis and use of the LCA SimaPro program,
- Use the WARM model to estimate the carbon footprint, cost and taxation of a solid waste management system,
- To compare energy recovery methods in waste management in terms of environmental footprint,
- Perform a life cycle cost analysis on a solid waste management system using full cost accounting (FCA) principles,
- Apply circular economy principles on solid waste management.

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Specialized knowledge in the control and design of solid waste treatment systems, mainly municipal, based on circular economy principles and life cycle analysis principles. Emphasis on current (state of the art) technological systems in the treatment of solid waste
- Acquiring knowledge so that students can proceed to additional postgraduate and doctoral studies
- Demonstrate social, professional and ethical responsibility and sensitivity to gender issues
- Autonomous work
- Work in an international and interdisciplinary environment
- Generation of new research ideas
- Protection and respect for public health and the environment
- Promotion of free, creative and inductive thinking

3. SYLLABUS

1. Circular economy in solid waste management (SWM). Principles-Examples. 3R principles
2. Waste biomass: Energy recovery and valorization
3. End of waste criteria in waste recycling and best practices
4. Methodologies and programs for the prevention of solid waste generation in the world.
5. Design of municipal waste (MSW) reuse and recycling systems – International practices.
6. IPCC principles in solid waste management – Trends in gaseous emissions
7. Policies and measures: Solid waste management and climate change
8. Integrating Financial Incentives and Taxes into Waste Management – Global Practices
9. Life cycle analysis in SWM – Basic principles
10. Life cycle analysis in SWM – Application of SimaPro & WARM software
11. Plastic waste management – Bioplastics, biodegradable plastics, microplastics
12. Quality and safety of soil improvers from waste or residues
13. Modern ash management and waste gas cleaning systems from waste incineration plants

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching and communication with students
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*	

Activity	*Semester workload*
Lectures	26
Study of literature –non-directed	45
Design projects	86
Presentation of assignments and projects	10
Field trip	5
Study for final exams	50
Final exam	3
Course total	*225 hours*

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	5-5 assignments during the semester, either individually or in groups (70% grade weight) Final oral (remote) exam (30%).

5. ATTACHED BIBLIOGRAPHY

Slides, texts and design sheets (in electronic format) that will be made available to the students via eclass.

Material from internet

Recommended books (in Greek):

Κομίλης, Δ., 2021. Διαχείριση και Μηχανική Στερεών Αποβλήτων. Εκδόσεις Τζιόλας, Θεσσαλονίκη (2η εκδ).

Γιδαράκος, Ε., Αϊβαλιώτη, Μ. 2021. Επικίνδυνα Απόβλητα: Διαχείριση, Επεξεργασία, Διάθεση, ΕΑΔΠΚ, Πολυτεχνείο Κρήτης, Χανιά (2η εκδ.)

COURSE OUTLINE

1. GENERAL

SCHOOL	FACULTY OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	MASTER		
COURSE CODE		**SEMESTER**	2nd
COURSE TITLE	DYNAMIC MODELLING AND CONTROL OF WASTEWATER TREATMENT PLANTS		

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	2	7.5
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 Skills development
PREREQUISITE COURSES:	Wastewater management and treatment technologies (1st semester)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek/English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC363/ https://eclass.duth.gr/courses/1424441/

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 aims at providing specialized knowledge on the simulation of processes for the wastewater treatment and the control of wastewater systems. It consists of two parts, which provide the following outcomes:

1. Cognitive

- Understanding and familiarity with the research objects of the Laboratory of Wastewater

Management and Treatment Technologies which include among others:
• Application of new technologies for the automatic control of biological nutrient removal processes
• Dynamic simulation of activated sludge processes and anaerobic digestion of waste sludge using the modeling program STOAT
• Mathematical model structure for the simulation of bioprocess
• Anaerobic digestion model
• Parameters of monitoring and control methods of anaerobic digesters
2. Skills
• Acquiring the ability to evaluate advanced technologies about automatic control of biological processes in wwtp's
• Acquiring the ability to use the STOAT simulation program
• Utilization of Aquasim software
• Simulation of anaerobic digestion process with the anaerobic digestion model

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

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working in an interdisciplinary environment

3. SYLLABUS

1. Automatic process control of Liquid Waste Treatment Units
2. Types of control – selection of specified points – Elements of automatic control systems - Examples of automatic control of processes in wwtp's
3. Dynamic simulation of wastewater treatment units – Introduction to STOAT.
4. Learning and training in STOAT (basics)
5. Learning and training in STOAT (A2O system)
6. Learning and training in STOAT (Anaerobic Digestion of Waste Sludge)
   Presentation of student work design exercise using STOAT / Examination
7. Mathematical simulation of biochemical processes. Stoichiometry of reactions. Stoichiometry of microbial growth reactions based on thermodynamics. Kinetics of enzymatic reactions and microbial growth rate reactions. Mass balances in reactors of continue operation (ideal and non-ideal). Models in tabular form.
8. Anaerobic digestion model (ADM1). Anaerobic stages considered in ADM1. Growth and inhibition rates, interactions. Physicochemical and biochemical processes in ADM1. Model reduction (rate limiting step) – perturbation analysis

9. Introduction to Aquasim software. Application of Aquasim on simple models. Bioprocesses of one or two stages which take place in batch or continuous stirred tank reactors and their introduction to aquasim for simulation and parameter estimation. Results illustration.
10. Application of ADM1 via Aquasim software (simulation of olive mill wastewater digestion, sewage sludge digestion)
11. Monitoring techniques of anaerobic digesters. Measureable variables in anaerobic digesters solid, liquid and gas phase and their usage in control systems
12. Control of anaerobic digesters. Control systems: set-point control systems, optimization control systems, cascade control systems, expert systems
13. Project presentation

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	*Distance learning*
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	*Use of ICT in teaching Χρήση Τ.Π.Ε. στη Διδασκαλία* *e-class for asynchronous education (10%)* *MS Teams for synchronous teaching (90%)* *e-mail for communication with students*
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*	*Activity* / *Semester workload* Part A Lectures/ Theory: 26 Literature study: 45 Elaboration of individual work: 112 Preparation and Presentation of the work: 42 Course total: *225*
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	• Creating assignments of design exercise using STOAT (40% of the grade) • Final oral exams (10% of of the grade) • Project on aquasim and ADM1 (40% of the grade) • Final written exam (10% of the grade)

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. *Course of lectures available in e-class*
2. *STOAT manuals, Installation and User Guide, Process Model Descriptions, Unit Process Descriptions*
3. *Aquasim manuals*
4. *Batstone, Damien & Keller, J & Angelidaki, Irini & Kalyuzhnyi, Sergey & Pavlostathis, S & Rozzi, A & Sanders, W & Siegrist, H & Vavilin, Vasily. (2002). Anaerobic digestion model No 1 (ADM1). Water science and technology : a journal of the International Association on Water Pollution Research. 45. 65-73.*

Related academic journals:

Bioreseource Technology
Water Research
Environmental Science and Technology
Waste Management

COURSE OUTLINE

1. GENERAL

SCHOOL	FACULTY OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	MASTER		
COURSE CODE		SEMESTER	2st
COURSE TITLE	ADVANCED WASTEWATER TREATMENT TECHNOLOGIES AND WATER RECLAMATION		
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
		3	7,5
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*	General background		
PREREQUISITE COURSES:	Wastewater management and treatment technologies (1st semester)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek/English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/TMC211/		

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*

1. Cognitive

Understanding and familiarity with the research objects of the Laboratory of Wastewater Management and Treatment Technologies which include among others:

• Biosensors application on order to control aerobic and anaerobic wastewater treatment methods

• Automatic control strategies of activated sludge processes

• Anaerobic digestion, increased biogas production by co-digestion with agro-industrial waste
•Fundamentals of technologies of olive mill wastewater treatment
•Fate of xenobiotics in sewage during municipal wastewater treatment
•Technologies of food waste treatment (e.g. cheese whey wastewater) for recovering high added value products and energy.
• Fundamentals of microbial fuel cell technology for the production of electrical energy from municipal wastewater
• Emerging technologies for a low carbon footprint wastewater treatment
• Odor control in sewage networks
• Solid waste leachate treatment by biological processes
• Biotechnological methods for nutrient removal from wastewater with emphasis on the denitrifying phosphorus removal process
2. Skills
- Acquiring the ability to evaluate advanced technologies for biological wastewater treatment
- Skills to control the wastewater treatment processes

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

3. SYLLABUS

1. A modified UCT method for biological nutrient removal: Configuration and performance
2. Development and implementation of microbial sensors for efficient process control in wastewater treatment plants
3. Process development for anaerobic co-digestion of agro-industrial wastewaters with sewage sludge from biological wwtp and by-products utilization
4. Advanced process control in activated sludge systems - wastewater reclamation using membranes
5. Treatment of food industry waste and recovery of useful products and energy
6. Olive mill waste management methods
7. Fate of xenobiotic compounds in municipal wastewater
8. Microbial fuel cells for municipal wastewater treatment
9. Enhancement of anaerobic digestibility of lipids and optimization of biogas production by implementing emulsification as pre-treatment method
10. Development of emerging technologies for a low carbon footprint wastewater treatment
11. Odor control in sewage networks
12. Biological processes in the treatment of landfill leachate

13. Modified DEPHANOX plant performing enhanced biological phosphorus removal Work presentations

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching, Communication with students
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*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures/ Theory</td><td>39</td></tr><tr><td>Literature study</td><td>90</td></tr><tr><td>Elaboration of individual work</td><td>82</td></tr><tr><td>Preparation and Presentation of the work</td><td>14</td></tr><tr><td>Total Course</td><td>225</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	Students' Learning and Performance is assessed by • Creating bibliographic assignment and its presentation (50% of the final mark) • Final written or oral exams (50% of the final mark)

5. ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*
  1. *Course of lectures available in e-class*

2. *Wastewater Engineering: Treatment and Resource Recovery 5th Edition*

COURSE OUTLINE

1. GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Environmental Engineering		
LEVEL OF STUDIES	M.Sc. degree		
COURSE CODE		SEMESTER	2nd
COURSE TITLE	Environmental Microbiology		
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
		2	7.5
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:	Not required		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (English for ERASMUS students)		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

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*

Upon successful completion of the course, students will be able to:

• understand the structure and physiology of microbial communities in biosystems treating wastes

• understand the abundance, evenness and biodiversity of microbial communities during waste/wastewater treatment

• understand the role of microbial communities in nutrients' removal during biotreatment

• understand the biodegradation processes and the role of specialized microorganisms in effluent quality

• understand the microbial processes and the specific role of microbial communities in wastewater treatment and composting
• familiarize with modern molecular techniques applied to optimize biotreatment processes

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas
- Project planning and management
- Respect for the natural environment
- Incorporating Sustainable Environmental Practices
- Production of free, creative and inductive thinking

3. SYLLABUS

- Microbial nutrition and physiology
- Wastewater treatment and bioindicators
- Activated sludge formation and properties
- Filamentous microorganisms in WWTPs
- Microbial composition in wastewater treatment systems
- Anammox bacteria
- Polyphosphate Accumulating Organisms (PAOs)
- Factors affecting the biodiversity in waste treatment systems
- Functional microbial groups in landfills
- Microbial succession during composting process
- Functional microbial groups during anaerobic digestion
- Ecological relationships and microbial interactions in WWTPs
- Advanced molecular techniques in waste treatment

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	100% Distance Learning (90% synchronous and 10% asynchronous learning), whereas the final exam of the course will be held with physical presence.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching and communication with students
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* *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.*	• Language of Evaluation: Greek • Semester essay examination (50% of the total marks) and Final Written Exam (50% of the total marks) <u>For Erasmus students:</u> • Language of Evaluation: English • Semester essay examination (100% of the total marks)

Activity	*Semester workload*
Lectures	26
Essay writing	120
Study and analysis of bibliography	79
Course total	*225*

5. ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Pepper, I. L., Gerba, C. P., Gentry, T. J., & Maier, R. M. (Eds.). (2011). Environmental microbiology. Academic press.
- Kirchman, D. L. (2018). Processes in microbial ecology. Oxford University Press.
- Bitton, G. (2005). Wastewater microbiology. John Wiley & Sons.

- *Related academic journals:* Scientific papers from international databases (Scopus, Scholar etc.)

COURSE OUTLINE

1. GENERAL

SCHOOL	FACULTY OF ENGINEERING		
ACADEMIC UNIT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	POSTGRADUATE STUDY PROGRAM I		
COURSE CODE		SEMESTER	2
COURSE TITLE	SIMULATION OF GROUDWATER FLOWS		
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
		3	7.5
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 SPECIALISED		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://eclass.duth.gr/courses/1424442/		

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*

Knowledge-based

- Student introduction to the principles of groundwater flows.
- Comprehending complexes processes of groundwater hydraulics .
- Understanding the heat and mass processes in aquifers
- Comprehending the trends in groundwater flow research

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Working in an interdisciplinary environment
- Production of new research ideas
- Respect for the natural environment

3. SYLLABUS

1 Introduction. Fundamentals of groundwater hydraulics. The principles of groundwater simulation
2. Types of aquifers. The laws of groundwater motion.
3. Examples of conventional groundwater simulation models I
4. Examples of conventional groundwater simulation models II
5. The double porosity / double permeability model I: The fundamental principles and equations
6 . The double porosity / double permeability model II: Recent developments and trends
7. The discrete fracture model I: Introduction

8. The discrete fracture model II: recent developments and application examples
9. Simulation of karst aquifers
10. Groundwater / surface water interactions
11. Mass transport simulation in aquifers I
12. Mass transport simulation in aquifers II
13. Geothermal energy. Simulation and applications

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching and communication with students.
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* *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.*	Assessment Language: Greek Short Answer Questions and Problem Solving 50% Semester project (individual) 50%

Activity	*Semester workload*
Lectures	40
Exercises	50
Bibliographic research & analysis	50
Individual semester Project	70
Project presentation	15
Course total	***225***

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography :

1. *Bear, J., 1979. Groundwater hydraulics. McGraw, New York.*
2. *Delay, F., Ackerer, P., 2016. The reduction of hydrological models for less tedious practical applications. CR Geosci. 348 (2), 89-98.*
3. *Fillion, E., Noyer, M. L., 1996. Flow modelling in a dual porosity domain with automatic mesh generation and parameter calibration: application to the Äspö site. J. Hydrol. 180(1-4), 1-19.*
4. *Maréchal, J. C., Dewandel, B., Subrahmanyam, K., 2004. Use of hydraulic tests at different scales to characterize fracture network properties in the weathered-fractured layer of a hard rock aquifer. Water Resour. Res. 40 (11).*
5. *Moutsopoulos, K. N., Konstantinidis, A. A., Meladiotis, I. D., Tzimopoulos, C. D., Aifantis, E. C., 2001. Hydraulic behavior and contaminant transport in multiple porosity media. Transp. Porous Media, 42 (3), 265-292.*

6. *Moutsopoulos, K. N., & Tsihrintzis, V. A. (2005). Approximate analytical solutions of the Forchheimer equation. Journal of Hydrology, 309(1-4), 93-103.*
7. *Moutsopoulos, K. N., 2013. Solutions of the Boussinesq equation subject to a nonlinear Robin boundary condition. Water Resour. Res. 49 (1), 7-18.*
8. *Moutsopoulos, K. N. (2010). The analytical solution of the Boussinesq equation for flow induced by a step change of the water table elevation revisited. Transport in porous media, 85(3), 919-940.*
9. *Moutsopoulos, K. N. (2021). A simple model for the simulation of the flow behavior in unconfined double porosity aquifers. Journal of Hydrology, 596, 126076.*
10. *Reimann, T., Geyer, T., Shoemaker, W. B., Liedl, R., Sauter, M., 2011. Effects of dynamically variable saturation and matrix-conduit coupling of flow in karst aquifers. Water Resour. Res. 47 (11).*
11. *Upadhyaya, A., & Chauhan, H. S. (1998). Solutions of Boussinesq equation in semiinfinite flow region. J. Irrig. Drain. E-ASCE 124 (5), 265-270.*

- Related academic journals:

1. *Journal of Hydrology*
2. *Transport in Porous Media*
3. *Water Resources Research*

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	MASTER		
COURSE CODE		SEMESTER	2
COURSE TITLE	WATER CYCLE MONITORING AND MODELLING SYSTEMS		
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
		2	7.5
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*	Specialized general knowledge		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK AND ENGLISH		

IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

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 scope is the presentation and the comprehension of the basic systems related with the monitoring and the modelling of the processes included in water cycle, either the natural or the urban.

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Autonomous work
- Team work
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism

- Production of free, creative and inductive thinking

3. SYLLABUS

1. Water cycle
2. Analysis of the extreme phenomena of the water cycle
3. Numerical modelling
4. Geographical information and water resources
5. Satellite data for water resources management
6. Urban hydrology I
7. Urban hydrology II
8. River plumes I
9. River plumes II
10. Meteorological forecasting
11. Hydrometry in rivers and floodplains
12. Monitoring systems for coastal processes
13. Revision – exams

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching E-class (Asynchronous education 10%) Synchronous education with Teams platform (90%) Using emails for the communication with the students
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* *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.*	Semester projects and final exams.

Activity	*Semester workload*
Lectures	12
Hands on	14
Study and analysis of bibliography	89
Project	80
Course total	**195**

5. ATTACHED BIBLIOGRAPHY

- Beer, T. (1996). Environmental oceanography (Vol. 11). CRC Press.
- Szymkiewicz, R. (2010). Numerical modeling in open channel hydraulics. Springer.

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	MASTER		
COURSE CODE		SEMESTER	2
COURSE TITLE	HYDROINFORMATICS		
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
		2	7.5
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*	Specialized general knowledge		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK AND ENGLISH		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)			

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 scope is the introduction in the concept of Hydroinformatics which is an interdisciplinary scientific field coupling the water-related scientific fields, such as hydrology, hydraulics, water resources management, etc. and the computer science.

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Autonomous work
- Team work
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking

3. SYLLABUS

14. Introduction
15. Numerical analysis I
16. Numerical analysis II
17. Differential equations I
18. Differential equations II
19. Optimization I
20. Optimization II
21. Introduction in hydraulic engineering
22. Rainfall-runoff
23. Open channel flows
24. Pressure-driven flows
25. Groundwater flows
26. Revision - exams

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of ICT in teaching E-class (Asynchronous education 10%) Synchronous education with Teams platform (90%) Using emails for the communication with the students
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*	*Activity* / *Semester workload* Lectures — 12 Hands on — 14 Study and analysis of bibliography — 89 Project — 80 Course total — **195**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	Semester projects and final exams.

5. ATTACHED BIBLIOGRAPHY

- Szymkiewicz, R. (2010). Numerical modeling in open channel hydraulics. Springer.
- Eslamian, S., Eslamian, F. (2022). Handbook of hydroinformatics. Elsevier.

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF ENVIRONMENTAL ENGINEERING		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE		SEMESTER	SECOND
COURSE TITLE	PHYSICAL PROCESSES AND COMPUTATIONAL METHODS IN THE COASTAL ZONE		

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	2	
EXERCISES	1	
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*	SPECIALIZED KNOWLEDGE
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

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*

(1) Introducing students in the modern requirements of legislation (EU and national) on the monitoring of the coastal zone,
(2) Introducing students in the concepts of applied simulations in the coastal environment,
(3) Presenting the processes of advection, diffusion and mixing of pollutants in one- and two-dimensional flows,
(4) Understanding the basic equations describing the processes of advection

and dispersion of pollutants in coastal seas.

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

The course provides the students with the capacity to acquire the following competences:

(1) Searching, collecting, analyzing and processing coastal zone data from external databases openly available from the web,
(2) Selecting and configuring the most appropriate numerical model per test case,
(3) Gaining the theoretical background and basic principles of pollutants' and flow simulation,
(4) Conducting a team assignment on the application of a coastal numerical model.

3. SYLLABUS

The course focuses on the description of physical processes in the coastal zone and seas through mathematical equations. Processes like the advection and dispersion of pollutants from urban wastewater treatment plants and industrial diffusers, the influence of water column dynamics (mixing/stratification) on the submarine plumes and jets, the wind-induced flow, the barotropic and baroclinic circulations are some of the topics discussed in the lectures. Students will be informed on:

A) The existing web-based databases to search, collect and process coastal data and integrate them into numerical simulations,
B) The application of selected numerical models for specific cases,

C) The calibration and validation of numerical models using field data and the scenario analysis using the model,
D) The preparation of technical reports to present and analyze the results of numerical simulations.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	DISTANCE LEARNING
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	USE OF TEAMS IN TEACHING AND COMMUNICATING WITH STUDENTS; USE OF E-CLASS FOR STORING COURSE RESOURCES; NUMERICAL MODELING IN MATLAB AND R PROGRAMMING LANGUAGES.
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*	*Activity* / *Semester workload* LEACTURES: 40 EXERCISES: 30 Course total: **70**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *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.*	EVALUATION THROUGH WEEKLY EXERCISES AND TEAM ASSIGNMENT.

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals: