8.20 CE0853 - Environmental Hydraulics

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0853**	**SEMESTER**	**8**
COURSE TITLE	**Environmental Hydraulics**		

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	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*	Specialisation Course
PREREQUISITE COURSES:	Fluid Mechanics (CE0430) English level B2 or higher is required for Erasmus incoming students
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (English/Erasmus)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/CIV217/

(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 to give the students fundamental concepts of the basic elements of development and application of numerical models in the scientific field of Environmental Hydraulics. Of particular importance is the knowledge of the scope and the necessary parameters that must be included in such a numerical model.

Upon completion of the course, students will have:

1. To determine the basic procedures for the transfer and mixing of pollutants in water recipients.
2. To develop and implement models of pollutant mixing.
3. To assess the quality of surface water.
4. To assess the environmental impact of the exploitation of water resources.
5. To assess the quality of surface water from anthropogenic activities
6. To select the appropriate liquid waste disposal device.

7. To participate in water resources management projects.

Specifically, students will be able to:

1. Have adequate comprehension skills of environmental hydraulics engineering
2. Evaluate the problems of pollutant mixing.
3. Manage time in an appropriate manner.

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…*

Specifically, students will be able to perform:

- Search for, analysis of, and synthesis of data and information, implementing appropriate technologies.
- Independent work - Team work - Working in an international / interdisciplinary environment.
- Decision-making
- Proact free, creative and inductive thinking

(3) SYLLABUS

1. Introduction. Fundamental concepts of water flow in the environment; basic concepts and definitions (concentration, dilution, stratification, etc.).
2. Sources and types of pollution in surface water systems..
3. Pollutant transfer procedures.
4. Dimensional analysis.
5. Introduction to turbulence. The nature and simulation of turbulence. Turbulent viscosity simulation (algebraic models, one-equation models, two-equation models, etc.).
6. Flow field of velocities and concentrations.
7. Initial and boundary conditions.
8. Basic mixing mechanisms (advection, diffusion, dispersion).
9. Fick's Law. Solutions for various initial and boundary conditions.
10. Mixing in natural channels. Turbulent diffusion and dispersion. Vertical, transverse and longitudinal mixing.
11. Analytical solutions and applications.
12. Measurement of discharge using a tracers.
13. Water quality in natural channels. One-dimensional water quality model.
14. River deoxygenation models. Organic pollution processes. The Streeter – Phelps model.
15. Mixing in reservoirs and lakes. Reservoir operation (annual cycle, stratification, etc.).
16. Turbulent buoyant jets (plane and round). Mixing in the near and far field. Stratification and currents.
17. Brines and thermals.
18. Mechanical disposal of wastewater to water bodies. Typical wastewater disposal systems (diffusers, multiple diffusers, rosettes etc.). Environmental and hydraulic design of outfalls.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face. When needed, distance teaching (synchronous/asynchronous)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Teaching using ICT, Communication and Electronic Submission.

Use of ICT in teaching, laboratory education, 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 examination is in Greek for resident students. Erasmus students are examined in English. Final written examination (2.5 hours): 60% (Problem- solving, multiple choice test, questions with short answers) Weekly home assignments and/or semester long project: 40% The exam layout is explained to the students well before the examination; weights per subject /exercise are explicitly indicated on the exam form. Examination results (including total grade and grade per subject) are posted on the course e-class site. Students can have access to their exam scripts on request; they may ask for clarifications on mistakes, grading etc.

Activity	*Semester workload*
Lectures	39
Classwork	45
Preparation for Project	34
Personal Study	32
Course total	**150**

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Krestenitis, I. N., Kobiadou, K. D., Makris, Ch., V., Androulidakis, I. S. and Karambas, Th. V. (2015), Coastal Engineering Marine Environmental Hydraulics (www.kallipos.gr) (in Greek). ISBN: 978-960-603-253-0
2. Demetriou, I. D. and Demetriou D. I. (2011) Environmental Hydraulics - Volume 1 Introduction. Fountas Publications (in Greek).ISBN: 978-960-330-675-7.
3. Antonopoulos, V. Z. (2010), Environmental hydraulics and surface water quality. Tziola Publications (in Greek). ISBN: 978-960-418-231-2.
4. Kotsovinos, N. and Aggelidis, P. (2008), Environmental Hydraulics. Spanidis Publications (in Greek). ISBN: 978-960-665-327-8.
5. Soulis, I. V. (2015), Computational Methods of Hydraulic Engineering (www.kallipos.gr) (in Greek).ISBN: 978-960-603-044-4.
6. Schnoor, J. L. (2003), Environmental models. Fate and transport of pollutants in air, water and soil. Tziola Publications (in Greek). ISBN: 978-960-805-097-6.
7. Sylaios, G. and Moutsospoulos, K. (2015), Environmental Computational Fluid Mechanics. (www.kallipos.gr) (in Greek).ISBN: 978-960-603-433-6.

Foreign Bibliography:

1. Benedini, M., and Tsakiris, G. (2013), Water quality modelling for rivers and streams. Springer Science & Business Media. ISBN: 978-94-007-5508-6.
2. Chanson, H. (2004), Environmental Hydraulics for Open Channel Flows, Elsevier. ISBN: 0-7506-6165-8.
3. Chin, D. A. (2007), Water-Quality Engineering in Natural Systems, John Wiley & Sons, Inc. ISBN: 978-0-471-71830-7.
4. Choy, B. and Reible, D. D. (2017), Diffusion models of environmental transport. CRC press ISBN 978-156-670-414-4.
5. Clercx, H. J. and Van Heijst, G. F. (Eds.) (2018). Mixing and dispersion in flows dominated by rotation and buoyancy. Springer International Publishing. ISBN 978-3-319-66886-4.
6. Cushman-Roisin, B. (2019), Environmental Fluid Mechanics (Lecture Notes),. (http://www.dartmouth.edu/~cushman/courses/engs151/chapters.html).

7. Fischer, H. B., List, J. E., Koh, C. R., Imberger, J. and Brooks, N. H. (1979), Mixing in inland and coastal waters. Academic press. ISBN 0-12-258150-4.
8. Grimshaw, R. (Ed.) (2002), Environmental stratified flows (No. 3). Springer Science & Business Media. e-ISBN 978-0-306-48024-9.
9. Holzbecher, E. (2012) Environmental Modeling Using MATLAB (2nd Edition), Springer-Verlag Berlin Heidelberg. ISBN: 978-3-642-22042-5
10. Katopodes, N. D. (2018), Free-Surface Flow: Environmental Fluid Mechanics, Butterworth-Heinemann. ISBN: 978-012-815-489-2.
11. Lee, J. H. W., Chu, V. and Chu, V. H. (2003), Turbulent jets and plumes: a Lagrangian approach (Vol. 1). Springer Science & Business Media. ISBN: 978-1-4615-0407-8.
12. Masters, G. M. and Ela, W. P. (2014), Introduction to Environmental Engineering and Science (3rd Edition), Pearson. ISBN: 978-1-292-02575-9.
13. Mihailovic, D. H. and Gualtieri C. (Eds.) (2010), Advances in Environmental Fluid 1. Advances in Environmental Fluid Mechanics, World Scientific. ISBN 978-981-429-300-6.
14. Rodi, W. and Uhlmann, M. (Eds.) (2012) Environmental Fluid Mechanics. Memorial Volume in Honour of Prof. Gerhard H. Jirka., CRC Press. ISBN 978-0-203-80396-7.
15. Rubin, H. and Atkinson, J. (1999), Environmental Fluid Mechanics, CRC Press. ISBN 978-082-478-781-3.
16. Vijay, P. S. and Hager, W. H. (1996), Environmental Hydraulics, Springer-Science & Business Media. ISBN: 978-90-481-4686-4.

Related academic journals:

1. Environmental Fluid Mechanics
2. Environmental Monitoring and Assessment
3. Environmental Processes