8.1 CE0810 – Water Wave Mechanics and Port Engineering

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	CIVIL ENGINEERING DEPARTMENT		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**CE0810**	**SEMESTER**	**8**
COURSE TITLE	**Water Wave Mechanics and Port Engineering**		

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**
	4	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*	Specialization Course
PREREQUISITE COURSES:	-- 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/CIV219/

(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 purpose of the course is to help students understand: a) the selection criteria for seaport location, geographical orientation and type, b) positioning and sizing of external protective structures and internal port structures for loading and other works, based on the design vessel dimensions, the bathymetric map of the area and the direction, characteristics and break depth of the prevailing waves in the port area, c) all significant loads on vertical wall breakwaters and quay walls, d) cross–section design and stability analysis of rubble mound and vertical wall breakwaters and quay walls of various types.

By the end of this course, students will be able to:

- Draw a port layout on a bathymetric map for a specific design ship and with knowledge of the prevailing wave conditions in the area of interest.
- Review the layout of an existing port and propose changes to service larger ships than the design ship.
- Choose the most suitable type of breakwater, design its cross-section based on typical cross-sections from PIANC's handbooks and other sources, make an initial sizing, calculate all the loads it receives, perform a stability analysis and resize, if necessary.
- Check and suggest improvements in a proposed breakwater cross-section.
- Design a new or check a proposed concrete block quay wall cross-section, as well as the rubble mound relief prism behind the quay wall, based on typical quay wall cross-sections. Calculate all the loads (with special attention to seismic loading) that the quay wall receives and make all the required stability checks under different load combinations.

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	*Search for, analysis and synthesis of data and information, with the use of the necessary technology*
Adapting to new situations	*Adapting to new situations*
Decision-making	*Decision-making*
Working independently	*Working independently*
Team work	*Team work*
Working in an international environment	*Working in an international environment*
Working in an interdisciplinary environment	*Working in an interdisciplinary environment*
Production of new research ideas	*Production of new research ideas*

The course aims that the student acquires - practice the following general skills:

- Search for, analysis of, and synthesis of data and information, implementing appropriate technologies
- Decision-taking
- Independent work - Team work - Working in an international / interdisciplinary environment
- Respect natural environment - Social, professional and ethical responsibility

(3) SYLLABUS

INTRODUCTION TO PORTS AND PORT WORKS
- Importance of ports and port works
- Types of ports and port structures

INTRODUCTION TO WATER WAVE MECHANICS
- Real waves, Energy wave spectrum
- Design Wave
- Linear theory of waves of small amplitude
- Wave transformations: shoaling, refraction, diffraction, breaking, reflection and run-up
- Standing waves, Hydrodynamic loading of a vertical wall structure due to a standing wave

BASIC PORT DESIGN PARAMETERS
- Seabed morphology, Meteorological conditions, Oceanographic research
- Sediment transport, Geotechnical survey, Seismic loading, Return period
- Vessel types, principal dimensions of a ship, tables of ship dimensions

PORT LAYOUT
- Navigation channel, Port entrance, Turning circle, General layout of external and internal port structures

EXTERNAL PORT STRUCTURES
- Rubble mound breakwaters
  (Cross-section types, Wave run-up and transmission, Submerged breakwaters, Dimensioning and stability issues, Armour layer and cross-section design, Construction issues)
- Vertical wall breakwaters

(Height above the SWL of the oscillation center, Wave transmission, Wave Loading, Cross-section design, Overturning, sliding and settling stability analysis, General shear failure of the soil, Construction issues

INTERNAL PORT STRUCTURES

Quays and quay walls

Types of quay walls

Quay wall loads - Seismic loading

Load combinations

Overturning, sliding and settling stability analysis, General shear failure of the soil

Gravity quay walls (Description, Construction issues)

Quay equipment, Layout of a general cargo port terminal. Silos and other facilities.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face in-class teaching. When needed, distance teaching (synchronous/asynchronous)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of I.C.T. in Teaching and Student Communication
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 (English/Erasmus) Written examination, 2,5-hours Problem solving, Multiple choice test, Questions and Answers, Written Essay / Project The evaluation criteria are announced to the students well before the examination; weights per subject /exercise are explicitly indicated. The examination results (including total / partial grading) are announced on the web. Students may require to have access to their tests, they may ask for clarifications on mistakes, grading etc.

Activity	***Semester workload***
In Class (/Distance) Teaching	52
Literature Study	39
Exercises / Paradigms	30
Project assignment / Essay	29
Course total	**150**

(5) ATTACHED BIBLIOGRAPHY

Greek Bibliography:

1. Δασκαλάκης, Μ. Κ., «Λιμάνια Θαλάσσια Κύματα Λιμενικά Έργα», Εκδόσεις ΣΕΛΚΑ - 4Μ ΕΠΕ, 2009.
2. Καραμπάς, Θ., Δήμας, Α, και Λουκογεωργάκη, Ε., «Ακτομηχανική και Λιμενικά Έργα», Εκδόσεις ΔΙΣΙΓΜΑ ΙΚΕ,
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4. Κουτίτας, Κ., «Εισαγωγή στην Παράκτια Τεχνική και τα Λιμενικά Έργα» , Εκδόσεις Ζήτη, Θεσσαλονίκη, 1998.

5. Μέμος, Κ., «Εισαγωγή στα Λιμενικά Έργα» , 3η έκδοση, Εκδόσεις Συμμετρία, Αθήνα, 2013.
6. Μουτζούρης, Κ.Ι., «Θαλάσσια Υδραυλική», Φοιτητικές Σημειώσεις για το μάθημα Θαλάσσια Υδραυλική και
7. Λιμενικά Έργα, 8ο εξαμ. Πολιτικών Μηχανικών ΕΜΠ, Αθήνα, 1996.

Foreign Bibliography:

1. U.S. Army Corps of Engineers, "Hydraulic Design of Small Boat Harbors," Engineer Manual, Publication No: EM 1110 - 2-1615, Proponent CECW – EH - D, Washington D.C., 1984. (διαθέσιμοστοδιαδίκτυο).
2. U.S. Army Corps of Engineers, "Coastal Engineering Manual," Engineer Manual, Publication No: EM 1110-2-1100–Parts I-V & Appendix, Proponent CECW-EW, Washington D.C., 2008. (διαθέσιμο στο διαδίκτυο).
3. Dean R.G. and Dalrymple R.A., "Water Wave Mechanics for Engineers and Scientists" Prentice-Hall, 1984.
4. Mei, C.C., "The Applied Dynamics of Ocean Surface Waves, "Advanced Series on Ocean Engineering - Volume 1, World Scientific, 1989.
5. Sorensen, R.M, "Basic Coastal Engineering," John Wiley & Sons, Inc, 1978.