COURSE OUTLINE

(1) GENERAL

SCHOOL	**UNIVERSITY OF THESSALY**		
ACADEMIC UNIT	DEPARTMENT OF CIVIL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ΥΔ0630**	**SEMESTER**	10
COURSE TITLE	DAMS AND HYDRAULIC STRUCTURES		

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	6
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, specialized general knowledge, skills development*	Specialized general knowledge, skills development
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. If there are ERASMUS students, material is given in English, and the subjects/exams of the course are in 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 has a technological character and covers the design of dams at the preliminary stage of the study. It includes the selection of the dam type, the siting and sizing of the basic technical works, and the hydraulic calculations of the safety works (diversion tunnel, spillway). The scope of the course is the introduction and the understanding of the design, construction and operation of dams and hydraulic structures. This course strengthens students' technical and intellectual competency, preparing them for engineering employment or advanced study. The course exposes students to hydrological methods of reservoir design, to design and construction of various types of dams, to design of hydraulic works of dams and to the management and simulation of the operation of dams and reservoirs.

Upon completion of the course, students should be able to demonstrate:

- Knowledge of the various dam types, their scope and operation
- Ability to define the location of dam construction
- Ability to calculate and design the reservoir volume with deterministic and stochastic methods
- Ability to calculate and design of hydraulic works of reservoirs (spillways, coffer dams, etc)
- Understanding of the design methods and typical tests of dams

- Understanding of the construction steps of various types dams
- Ability to design hydrodynamic-hydroelectric works
- Ability to manage and simulate the operation of dams and reservoirs single and multiple scope
- Understanding of the environmental impacts of dam construction and the methods for the impact alleviation

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
- Team work on Labs
- Working in an interdisciplinary environment
- Project planning and management
- Production of free, creative and inductive thinking
- Respect for the natural environment
- Showing social, professional and ethical responsibility

(3) **SYLLABUS**

Outline: Introduction to dams and associated projects. Basic design principles and general layout of dams. Reservoirs (characteristic elevations, hydrology, topography, elevation-surface-storage relationships, geology, seepage losses, sediments, storage-reliability-yield relationships). Dead volume estimation. Useful volume dimensioning through simulation. Dam construction elements, with emphasis on conventional vibrated concrete (CVC) roller compacted concrete (RCC) and hardfill. Diversion systems (tunnels, cofferdams). Spillway systems technology. Hydrological design of spill and diversion systems. Simulation of flood routing through ogees and diversion tunnels. Stepped spillways. Stilling basins. Water intakes. Dam monitoring. Dam failures. Dam breach studies. Environmental impact assessment and management. Architectural and landscape design.

Tasks: The semester project deals with the preliminary study of a dam. This is mandatory and is done in groups of up to two students. The study includes the selection of the type of dam, the design of the reservoir, the siting and sizing of the basic technical structures, and the hydraulic calculations of the safety works (diversion tunnel, spillway). At the end of it, a full technical report is delivered, with the accompanying drawings, which is presented on the day of the examination.

Course structure:

1. Introduction. Types and scope of dams. Dam location selection.
2. Gravity dams. Construction characteristics. Conditions and stability tests
3. Hollow Gravity dams. Construction characteristics. Conditions and stability tests. Arch dams. Types and calculation methods. Stability tests.

4. Earth-fill dams. Types and construction characteristics. Stability tests. Rock-fill dams. Types and construction characteristics.
5. Dam foundation and drainage. Percolation under the dams and through earth dams. Computation of percolation. Measures for the minimization of percolation.
6. Characteristics of reservoirs. Deterministic design of reservoir Calculation of reservoir usable volume (Rippl method, Dincer method, Stall method)
7. Probabilistic method for the calculation of reservoir usable. Moran method
8. Estimation of reservoir non-usable (dead) volume. Estimation of reservoir flood volume
9. Hydrologic and hydraulic design of dam safety works. Design of dam spillway and river diversion works. Design flood of spillway. Spillway design.
10. Design flood for river diversion. Flood protection during the dam construction and operation. Dam design.
11. Introduction in hydroelectric energy production. Hydroturbines and their types. Hydroturbine design.
12. Hydroelectric works. Design of small hydroelectric dams. Hydroelectric dam design. Estimation of hydroelectric energy production.
13. Deterministic and stochastic simulation of reservoir operation. Risk analysis of hydroelectric energy production.
14. Deformation monitoring of dam. Pore pressure, movement and temperature measurement equipment. Environmental impacts from dam construction, protection works and fish passage works.

(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*	Lectures with PowerPoint Notes, Exercises and Announcements in e-class

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	14 * 4 = 56 hours
Project	64 hours
Study	40 hours
Course total	***160***

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 for Erasmus students) **Teaching method:** The lectures of the course are combined with corresponding individual and/or group laboratory exercises and applications on which a significant part of the assessment is based. At the same time, comprehensive semester projects are prepared, with specific examples in which emphasis is placed on the utilization of the methods and analysis techniques presented. **Teaching Rationale:** To impart the basic theoretical and practical understanding represented by the knowledge and skills outcomes via a mix of self-learning and formal teaching, including formal lectures and practicals in the lab sessions with active student participation. Lectures introduce theory and concepts, which are then exemplified in computer workshops using specialist packages and tailored data sets. For modelling of dams and hydraulic structures, the theory underpinning modern practice is taught in lectures and then tested in practical lab sessions. **Evaluation method:** 100% Project: Integrated example of modelling of extreme hydrological phenomena. Compulsory delivery of project. Technical Report. Oral examination: presentation of the project. **Evaluation Rationale:** A substantial piece of coursework will test the students' ability to understand and apply the knowledge they acquire in practice at the lab sessions, including the use of methods and software. In addition, as it is an open-ended work it also tests students' initiative. Assessment will be 100% coursework. A headstart will be made using computational resources during the lab sessions, with further analysis and writing up afterwards.

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

Greek Bibliography

Δερμίσης, Β., 2010. «Διευθετήσεις Υδατορρευμάτων», 1η Έκδοση, Εκδόσεις Τζιόλα, ISBN: 978-960-418-296-1.

Ελληνική Επιτροπή Μεγάλων Φραγμάτων (ΕΕΜΦ) (http://www.eeft.gr/)

Μιμίκου, Μ., 2006. «Τεχνολογία Υδατικών Πόρων», 3η Έκδοση, Εκδόσεις Α. ΠΑΠΑΣΩΤΗΡΙΟΥ & ΣΙΑ Ι.Κ.Ε., ISBN: 978-960-7530-79-0.

Μιμίκου, Μ.Α. και Ε.Α. Μπαλτάς, 2012. «Τεχνική Υδρολογία», Εκδόσεις Παπασωτηρίου.

Νικολάου, ΣΤ., 1990. «Μαθήματα Υδροδυναμικών Έργων», ΕΜΠ.

Παπαμιχαήλ, Δ.Μ., 2004. «Τεχνική Υδρολογία», Εκδόσεις Γιαχούδη.

Παπαντώνης, Δ.Ε., 2016. Μικρά Υδροηλεκτρικά Έργα, 460 σ., Εκδόσεις Τσότρας, Αθήνα, ISBN:978-618-5066-46-8.

Σούλης, Ι.Β. «Υδραυλικαί Στροβιλομηχαναί-Πρώτος Τόμος Υδροστρόβιλοι», Εκδόσεις Αιβάζης

Τσακίρης, Γ. «Υδατικοί Πόροι: Ι. Τεχνική Υδρολογία», Εκδόσεις Συμμετρία, 1995

Τσόγκας, Χ., και Ε. Τσόγκα, 2009. «Υδροδυναμικά Έργα – Φράγματα», 2η Έκδοση, Εκδόσεις Ίων, ISBN: 960-411-196-5.

English Bibliography

Cedergren, H.R., 1989, «Seepage Drainage and Flownets» 3rd Ed. J. Wiley & Sons

Eng. Found. Conf. Proc., 1977, «The Evaluation of Dam Safety», ASCE

Hartford, D. N. D., Baecher, G. B., 2004. Risk and uncertainty in dam safety, Thomas Telford.

Henderson, F.M. "Open Channel Flow", MacMillan Series in Civil Engineering, MacMillan Publishing Co. Inc, 1966.

Herzog, M.A.M., 1999, «Practical Dam Analysis», Thomas Telford.
Hoeg, K, 1993, «Asphaltic Concrete Cores for Embankment Dams», N.G.I.
Howard, T.R. (Ed), 1983, «Seismic Design of Embankments and caverns», ASCE
ICOLD Bulletins. International Commission on Large Dams (http://www.icold-cigb.net/GB/publications/bulletins.asp).
McMahon, T. A., and Adeloye, A. J., 2005. Water Resources Yield. Littleton: Water Resources Publications.
McMahon, T. A., and Mein, R. G., 1986. River and Reservoir Yield. Littleton: Water Resources Publications.
Morris, G.L. and Fan J., 1998. Reservoir Sedimentation Handbook, McGraw-Hill Book Co., New York.
Novak, P, Moffat, AI.B., Nalluri, C., Narayanan, R. 1996, «Hydraulic Structures», E & FN Spon, 2nd Ed.
Prentice, J.E., 1990, «Geology of Construction Materials», Chapman and Hall.
Smith, K, Ward, R., 1998, «Floods: Physical processes and Human Impacts, J. Wiley.
Vischer, O.I., Hager, W.H., 1998, «Dam Hydraulics», J. Wiley.
Zipparo, V.J., Hasen, H. (Ed.), 1993, «Davis' Handbook of Applied Hydraulics». McGraw Hill, INC.

- Related academic journals:

ICOLD Congresses Proceedings, Dams and Reservoirs, International Journal on Hydropower & Dams, International Journal of Water Resources Development, Water Resources Management, River Research and Application, Water Resources Research, Journal of Flood Risk Management, Journal of the American Water Resources Association, Wiley Interdisciplinary Reviews: Water, Journal of Hydraulic Engineering, Journal of Irrigation and Drainage Engineering, Journal of Hydrologic Engineering, Journal of Water Resources Planning and Management, Journal of Hydrology, Hydrology and Earth System Sciences, Natural Hazards and Earth System Sciences, Advances in Geosciences.