COURSE OUTLINE

(1) GENERAL

SCHOOL	**UNIVERSITY OF THESSALY**		
ACADEMIC UNIT	DEPARTMENT OF CIVIL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ΥΔ0620**	**SEMESTER**	8
COURSE TITLE	**Modelling of Surface Water and Groundwater Resources**		

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, 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)	https://eclass.uth.gr/courses/CULT_U_219/

(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 introduce and understand the computational techniques of surface and groundwater modelling. The course helps students to develop their technical and intellectual ability preparing them for work as engineers and for graduate studies. The course introduces students to deterministic and stochastic methods using computational surface and groundwater modelling tools.

At the end of the course students should have:

- Knowledge and understanding of the physical processes of surface and groundwater resources
- Ability to apply deterministic (lumped, semi-distributed and distributed) models to simulate surface and groundwater resources
- Knowledge and understanding of optimization of surface and groundwater models for operational applications
- Ability to calculate parameters of simulation models using GIS
- Ability to calculate the spatial distribution of quantitative and qualitative variables using deterministic, geostatistical, combinatorial and hybrid methodologies
- Ability to apply management scenarios for the simulation of surface and groundwater resources.

Skills
Upon completion of the course, the student possesses advanced skills in processing, analyzing and solving complex problems in the science of hydraulic engineering related to:

- Surface Hydrology
- Groundwater Hydrology and Hydraulics

Abilities
After completing the course, the student manages complex water resources projects and can make decisions on water resources management practices. He is also able to work individually and as a team when designing, managing and modelling such phenomena. Especially students will be able to:

- evaluate and judge technical and environmental factors in water resources planning, modelling and management process and
- synthesize and propose optimal or new solutions based on the above evaluation.

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**

1. Introduction. Mathematical models of rain-runoff. Classification of models. Presentation of surface and groundwater models.
2. Optimization techniques for surface water and groundwater models. Calibration of parametric deterministic models. Trial-and-Error and automatic calibration and validation of surface and groundwater models models.
3. Systems of hydrological modelling of large river basins.
4. Hydrological and hydraulic methods of flow routing. Coupling of surface water models with groundwater models.
5. Modelling of groundwater quality characteristics. Pollution propagation
6. Groundwater vulnerability and modelling procedures
7. Sea water intrusion into groundwater. Modelling theories and examples
8. Analysis of hydrological timeseries. Structure and characteristics of hydrological timeseries. Deterministic and stochastic components of timeseries.

9. Estimation of spatial distribution of hydrometeorological data. Deterministic (trend surfaces, regression, inverse distance weighting, splines) and geostatistical methods (ordinary and universal kriging)
10. Estimation of spatial distribution of hydrometeorological data. Geostatistical and combinational methods. Sequential Gaussian simulation
11. Use of Geographical Information Systems in hydrologic modelling. Estimation of watersheds and geomorphologic parameters with the use of GIS. Introduction to semi-distributed and distributed hydrologic models.
12. Applications of distributed models of surface and subsurface hydrology in river basins.
13. Uncertainty estimation of surface and groundwater models
14. Summary and theory revision - Concluding remarks

(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	30 hours
Course total	***150***

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 surface and groundwater systems, the theory underpinning modern practice is taught in lectures and then tested in practical lab sessions.

	Evaluation method: 100% Project: Integrated examples of modelling of surface water and groundwater resources. 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

Βουδούρης, Κ. 2022. Εκμετάλλευση και Διαχείριση Υπόγειου Νερού, 2η Έκδοση. Εκδόσεις Τζιόλα.

Καραμούζης, Δ. Υδραυλική και Διαχείριση Υπογείων Υδάτων. 2013 Εκδόσεις Γράφημα.

Κουτσογιάννης, Δ., Ξανθόπουλος, Θ., 1999. Τεχνική Υδρολογία [ηλεκτρ. βιβλ.] Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών (http://hdl.handle.net/11419/5888).

Μάρης, Φ., Παπαρίζος, Σ., Καράτζιος, Γ., 2014. Υδρογεωπληροφορική, Μοντελοποίηση και Πληροφοριακά Συστήματα Διαχείρισης Υδάτινων Πόρων. Εκδόσεις Δίσιγμα, ISBN: 978-960-9495-43-1.

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

Τολίκας, ΔΚ, 1997. Υπόγεια υδραυλική. Εκδόσεις Επίκεντρο, Θεσσαλονίκη.

Τσακίρης, Γ., 2012. Υδατικοί Πόροι Ι. Τεχνική Υδρολογία, Εκδόσεις Συμμετρία, ISBN: 978-960-266-380-6.

English Bibliography

Anderson, M.; Woessner, W.; Hunt, R. Applied Groundwater Modeling, Simulation of Flow and AdvectiveTransport; Academic Press: 2015.

Anderson, M.G., and J.J. McDonnell (eds.), 2005. Encyclopedia of Hydrological Sciences, Wiley Publications.

Bear, J. Hydraulics of groundwater; Courier Corporation: 2012.

Beven, K.J., 2012. Rainfall-Runoff Modelling: The Primer, 2nd Edition, Wiley-Blackwell.

Karamouz, M., Nazif, S., Falahi, M., 2013. Hydrology and Hydroclimatology: Principles and Applications. CRC Press.

Maidment, D.R., (ed.), 1993. Handbook of Hydrology. McGraw-Hill.

Mays, L.W., 2010. Water Resources Engineering, 2nd Edition, John Wiley & Sons.

Mimikou, M., Baltas, E. and Tsihrintzis, V., 2016. Hydrology and Water Resources System Analysis, July 2016, Textbook – 448 Pages – 208 B/W Illustrations, ISBN 9781466581302, CRC Press, Taylor and Francis Group.

Todd, D. K., & Mays, L. W. (2004). Groundwater hydrology. John Wiley & Sons.

- Related academic journals:

Advances in Water Resources, Environmental Modelling and Software, Groundwater, Groundwater Monitoring & Remediation, Journal of Hydrology, Hydrological Processes, Water, Hydrogeology Journal, Hydrology, Hydrological Sciences Journal, 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 Groundwater Science and Engineering Journal of Hydraulic Engineering, Journal of Irrigation and Drainage Engineering, Journal of Hydrologic Engineering, Journal of Water Resources Planning and Management, Hydrology and Earth System Sciences, Natural Hazards and Earth System Sciences, Advances in Geosciences.