COURSE OUTLINE

(1) GENERAL

SCHOOL	**UNIVERSITY OF THESSALY**		
ACADEMIC UNIT	DEPARTMENT OF CIVIL ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	GK3000	**SEMESTER**	6th
COURSE TITLE	Groundwater 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**
	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*	General Background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
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 completing the course, the student will have advanced knowledge, critically understanding theories and principles related to:

- Hydraulic laws for calculating saturated water flow in soil.
- Methods for solving flow in saturated porous media.
- Theoretical and computational background for addressing flow problems to trenches, wells, and boreholes in confined and unconfined aquifers, and flow through and under dams.

Skills

The student will acquire advanced skills to solve complex and unpredictable groundwater management problems using advanced methodologies, tools, and computational models.

Competencies

The student will:

Manage complex project designs and make decisions in unpredictable environments or technical issues.

Work independently and collaboratively in designing such projects.

Evaluate and consider technical, environmental, social, and economic factors during groundwater resource management and utilization projects.

Propose optimal or innovative solutions based on these evaluations.

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* *thinking 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* *……* *Others…* *…….*
• Search, analyze, and synthesize data and information using relevant technologies. • Adapt to new situations. • Decision-making. • Independent work and teamwork. • Project planning and management. • Respect for diversity and the natural environment. • Demonstrate professional and ethical responsibility. • Promote free, creative, and inductive thinking.

(3) SYLLABUS

No. of Week	Course Content
1	Characteristics of soils: Experiment and Darcy's law – scope of applicability. Exercises
2	Permeability coefficient, intrinsic permeability, permeameters. Applications.
3	Continuity equation: Mathematical model, flow networks, boundary types, and boundary conditions.
4	Analytical methods for solving the mathematical model: Finite difference method.
5	Anisotropic and heterogeneous soils: Analog and physical models.
6	Flow equation in confined aquifers and flow equation in unconfined aquifers: Dupuit assumption.
7-8	Steady flow to trenches: (a) Confined aquifer Unconfined aquifer. Exercises.
9-10	Steady flow to wells: (a) Confined aquifer Unconfined aquifer. Exercises.
11-13	Well systems: Image method. Exercises.
14	Transient (non-steady) flow: Seepage force and the phenomenon of piping.

(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*	• PowerPoint lectures • Notes and exercises • Announcements on e-class • Interactive teaching using software (e.g., Excel, GIS, MODFLOW)
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements,*	

Activity	*Semester workload*
Lectures and exercises	56 hours
Study	42 hours
Assignments	12 hours
Exams	3 hours
Exam preparation	15 hours

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*		
	Course total	*125 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.*	Assessment Methods: • Assignments: Up to 20% (non-mandatory). • Final Exam: Up to 100% (open books and notes, no audiovisual aids, theory questions, and problem-solving).	

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

- *Karamouzis, D. (2013). Hydraulics and Groundwater Management. Graphima Publications, Thessaloniki. (In Greek)*
- *Voudouris, K. (2022). Exploitation and Management of Groundwater, 2nd Edition. Tziola Publications, Thessaloniki. (In Greek)*
- *Tolikas, D. (1997). Groundwater Hydraulics. Epikentro Publications, Thessaloniki. (In Greek)*
- *Papanikolaou, P.N. (2007). Notes on Groundwater Hydraulics. (In Greek)*
- *Anderson, M., Woessner, W., & Hunt, R. (2015). Applied Groundwater Modeling. Academic Press.*
- *Bear, J. (2012). Hydraulics of Groundwater. Courier Corporation.*
- *Todd, D.K., & Mays, L.W. (2004). Groundwater Hydrology. John Wiley & Sons.*