COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MINERAL RESOURCES ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	MRE503	SEMESTER	5
COURSE TITLE	HYDROGEOLOGY		

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
Lectures	2	2
Lab exercises	2	2
Total	**4**	**4**
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*	Required, Special background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uowm.gr/courses/MRE141/

(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*

On successful completion of the course, students will be able to:

- ✓ Know the relationships between groundwater and surface water and their mutual balance.
- ✓ Estimate the mechanism of groundwater storage.
- ✓ Understand the laws that regulate the all-round physical movements of water.
- ✓ Point out the role that geological structures and various rock types play in the storage and movement of water.
- ✓ Analyze the pollution mechanisms of aquifers and effectively design the measures to reduce pollution and decontamination.

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…*
	…….

The course aims at:
Search, analysis and synthesis of data and information
Working independently
Production of free, creative and inductive thinking

(3) SYLLABUS

The modules in this course cover:

- Surface Hydrology: Origin of water, the objectives of Hydrogeology. Hydrological cycle in nature. Hydrological balance. Infiltration and filtration of water into the ground.
- Groundwater storage: Groundwater storage (porosity, role of rock formations). Distribution of groundwater (aquifers, types of aquifers). Piezometry and level fluctuations as environmental parameters. Overdrafts and consequences. Storage factor. Formation and types of aquifers. Feeding and relief zones. Aquifer systems, karst aquifer systems.
- Groundwater flow: Groundwater flow, Darcy law, permeability, groundwater action on the porous medium (aquifers, flowing sand phenomena). The movement of groundwater in the porous media, permeability and water permeability, transferability and storage ability, empirical ways of assessing water permeability through traces and granulometric analyses, flow networks and applications; hydraulic of groundwater, permanent and non-permanent flow, calculation of hydraulic parameters in permanent and non-permanent flow.
- Groundwater Quality: Physical and chemical properties of water. Groundwater quality data, sampling, water- subsoil reactions (Chemical composition of rainwater, Dissolution, Oxidation – Reduction, etc.), analysis – utilization of hydrochemical data (Hydrochemical maps, hydrochemical diagrams, ionic ratios). Classification of groundwater, Hydrochemical phases, etc.).
- Groundwater pollution: Main sources of qualitative degradation of groundwater aquifers and water. Propagation of pollutants. Pollutants – sources and causes of pollution (Pollutants, Urban pollution, Pollution from agriculture, industry, Pollution from Mines and Quarries, Pollution from

accidents, etc.), Dissemination of pollutants (Mechanical propagation of pollutants, etc.). Protection from pollution – Methods of decontamination.

- Laboratory: Hydrographic network, Calculation of hydrological balance, Calculation of porosity and permeability, Depiction of aquifers. Water quality diagrams using appropriate software.

(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*	Use of data projector, asynchronous training platform – eclass, laboratory education.
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 Assessment: Greek* *Evaluation methods:* *Theory: 60% Final Written Examination (Short Answer Questions, Essay Development Questions).* *Laboratory: Laboratory Exercises, Written Examination, Problem Solving 40%* Assessment criteria are provided in the course page on the eclass platform and are available to students from the start of the semester.

Activity	*Semester workload*
Lectures	55
Lab work	25
Lectures study	20
Course total	*100*

(5) SUGGESTED BIBLIOGRAPHY

- Suggested bibliography:

- ***Βουδούρης Κ. Σ. (2009). «Υδρογεωλογία περιβάλλοντος. Υπόγεια νερά και περιβάλλον». Εκδόσεις Α. ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε., 472 σελ.***
- ***Βουδούρης Κ. Σ. (2012). «Τεχνική Υδρογεωλογία». Εκδόσεις Α. ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε., 448 σελ.***
- ***Γκουντούλας Κ. (2016). «Γενική και Περιβαλλοντική Υδρογεωλογία». Εκδόσεις ΑΛΕΞΑΝΔΡΟΣ Σ. Ι.Κ.Ε., 260 σελ.***
- ***Σούλιος Γ. Χ. (2010). «Γενική Υδρογεωλογία». Εκδόσεις University Studio Press, 374 σελ.***
- ***Domenico Patrick A., Schwartz Franklin W. (1998). "Physical and Chemical Hydrogeology". 2nd Edition, Wiley & Sons, 506p., ISBN-13: 978-0471597629, ISBN-10: 0471597627***

- ***Fetter C. W. (2014). "Applied Hydrogeology". 4th Edition, 621p. ISBN-13: 978-1478637097, ISBN-10: 1478637099***
- ***Fetter C. W., Boving T., Kreamer D. (2018). "Contaminant Hydrogeology". (Kindle Edition) WAVELAND PRESS, INC., ISBN-13: 978-1478632795, ISBN-10: 1478632798, 647p.***
- ***Hiscock Kevin M., Bense Victor F. (2014). "Hydrogeology: Principles and Practice". 2nd Edition, WILEY Blackwell, 505p., ISBN-13: 978-0470656624, ISBN-10: 047065662X***
- ***Weight Willis (2019). "Practical Hydrogeology: Principles and Field Applications". 3rd Edition, 777p., ISBN-13: 978-1260116892, ISBN-10: 1260116891***

- Related academic journals:

- *Applied hydrogeology*
- *Hydrogeology Journal, Springer*
- *International Journal of Hydrology Science and Technology*
- *Journal of Hydrology, Elsevier*
- *Journal of Hydrogeology & Hydrologic Engineering*