COURSE OUTLINE Groundwater resources management

EDUCATION LEVEL	7		
CODE	WBCC-511ws	SEMESTER	2nd
TITLE	Groundwater resources management		
TEACHING ACTIVITIES	HOURS/WEEK	ECTS	
Lectures, Exersices	3	6	
TYPE OF COURSE	Main course in the specialization «Water scarcity»		
PREREQUISITE KNOWLEDGE	-		
LANGUAGE OF INSTRUCTION AND ASSESSMENT	Greek		
AVAILABILITY TO ERASMUS STUDENTS	-		
WEBSITE (URL)	https://eclass.uoa.gr/courses/GEOL574/		

LEARNING OUTCOMES

Learning Outcomes/Subject Specific Competences
The aim of the course is to provide postgraduate students with knowledge related to groundwater flow in aquifers, withdrawal methodologies, strategies to enhance reserves at both the micro- and macro- scales, the examination and treatment of pollution phenomena, and training postgraduate students in the use of specialized software for qualitative and quantitative monitoring of groundwater resources. Upon successful completion of the course, postgraduate students will gain the ability to: Understand the components of groundwater in the context of the hydrological cycle and how climate change affects the water balance equation. Elaborate programs for the qualitative and quantitative monitoring of groundwater resources. Evaluate the morphological, geological, hydrogeological, and tectonic conditions prevailing in a study area. Recognize the main hydraulic parameters of an aquifer and the direction of groundwater flow. Connect with the Greek and European institutional framework and the existing policies on water resources (national and cross-border). Understand how a simulation model works and the use and utility of innovative techniques that contribute to the understanding of groundwater flow in an aquifer. Determine the maximum possible amounts of water withdrawal to ensure the sustainability of the springs or boreholes is not disturbed. Leverage the use of Geographical Information Systems (GIS) in groundwater resources management. Evaluate quantitative and qualitative groundwater data, effectively assessing the status of the aquifer. Recognize common groundwater quality problems and trace their exact origin (geogenic or anthropogenic). Understand the occurrence, transport, dispersion, and fate of pollutants in groundwater and delve into methods of their removal or limitation.

Generic Competences
The generic competences that postgraduate students should have acquired within the course include: • Ability to convert theory into practice. • Problem-solving skills. • Ability to search, analyze, and synthesize data and information using necessary technologies. • Project planning and management. • Cultivation of respect for the natural environment. • Decision-making skills. • Individual and teamwork abilities.

COURSE CONTENT

The availability of fresh drinking water on the planet, especially under conditions of climate change, fluctuates and is not stable. However, what remains constant is the continuous increase in water demand, driven by the exponential growth of the Earth's population, particularly over the last 30 years. Considering that this upward trend is expected to persist in the coming decades, the pressure on water resources is undeniable. In these circumstances, groundwater resources management becomes particularly crucial, perhaps even more so than the corresponding surface water resources management.

Educational objects:

Studying the morphological, geological, hydrogeological, and tectonic conditions prevailing in the watersheds, along with the accompanying climatic data of an area.

Explaining the main hydraulic parameters of an aquifer.

Learning the operating mechanism of springs.

Determining groundwater flow through piezometric maps.
Explaining the hydrogeological model of groundwater flow – Mathematical simulation model.
Learning the water balance equation.
Utilizing tracers, remote sensing, and geographic information systems (GIS) to determine the groundwater flow in an aquifer.
Describing the quantitative and qualitative status of an aquifer, with a simultaneous depiction of the variation of its quantitative parameters spatially and temporally and creating bivariate correlation diagrams between various parameters.
Estimating the possible amount of water withdrawal, ensuring the sustainability of the springs.
Developing artificial recharge methodologies in cases of water scarcity.
Studying the water-rock/soil interaction process and the hydrogeochemical footprint in an aquifer.
Explaining common groundwater quality degradation problems.
Learning how to distinguish (geogenic vs. anthropogenic) and trace the sources of groundwater pollution.
Learning to create hydrogeological – hydrogeochemical maps by means of GIS.

LEARNING ACTIVITIES - TEACHING and ASSESSMENTS METHODS

MODE OF DELIVERY	Distance learning
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	Use of information and communication technology in teaching, laboratory education, and communication with postgraduate students. Use of specialized software for groundwater resources management. Support of the learning process through the e-class electronic platform. Communication with postgraduate students via email and the e-class electronic platform.
PLANNED LEARNING ACTIVITIES	Activity / Semester Workload Lectures: 39 h Practice Exercises: 25 h Bibliographic study & analysis: 90 hç Total: 154 h
ASSESSMENT METHODS AND CRITERIA	Final written examination (100%), which may include: -Essay questions. -Short-answer questions (SAQs). -Comparative evaluation of theoretical elements. -Closed-ended questions/Multiple Choice Test. -Problem-solving exercises. B. Exercises: Throughout the semester, postgraduate students are assigned exercises that must be completed and submitted by a specific deadline to enable participation in the final written exam.

TEXTBOOKS - BIBLIOGRAPHY

Suggested bibliography:
Greek bibliography
Voudouris, K. (2015). Groundwater exploitation and management. Tziola Publications. [in Greek]
Stournaras, G. (2007). Water: environmental dimension and route. Tziola Publications. [in Greek].
Foreign language bibliography
Appelo, C. A. J., & Postma, D. (2004). Geochemistry, groundwater and pollution. CRC press.
Karamouz, M., Ahmadi, A., & Akhbari, M. (2020). Groundwater hydrology: Engineering, planning, and management. Crc Press.
Todd, D. K., & Mays, L. W. (2004). Groundwater hydrology. John Wiley & Sons.
Kresic, N. (2006). Hydrogeology and groundwater modeling. CRC press.
Directive, W. F. (2000). EU Water framework directive. EC Directive, 60.
Related scientific journals:
Water resources management [Springer].
Environmental Earth Sciences [Springer].
Hydrogeology [Springer].
Groundwater for Sustainable Development [Elsevier].
Agricultural Water Management [Elsevier].
Water Research [Elsevier].
Water [Mdpi].