COURSE OUTLINE

1. GENERAL

SCHOOL	APPLIED SCIENCES		
DEPARTMENT	**ENVIRONMENTAL ENGINEERING**		
LEVEL OF STUDY	UNDERGRADUATE		
COURSE UNIT CODE	GE5410	**SEMESTER OF STUDY**	4^{o}
COURSE TITLE	**ENVIRONMETAL HYDROGEOLOGY**		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
	4	4,5

COURSE UNIT TYPE	SC: Specialization Courses
PREREQUISITES:	Evaluated knowledge of the course "Environmental Geology".
LANGUAGE OF INSTRUCTION/EXAM:	Greek/English
COURSE DELIVERED TO ERASMUS STUDENTS	YES
MODULE WEB PAGE (URL)	http://geope.teikoz.gr/undergraduate/ug_studies.htm

2. LEARNING OUTCOMES

Learning Outcomes

•

The aim of the course Environmental Hydrogeology is the promotion of knowledge in this area. Specifically promotes:

a) better, more rational, safer exploitation of groundwater, combined with rational management of all water resources.

b) development of methods for aquifers searching and

c) protection of water from pollution - mainly anthropogenic contamination sources.

General Skills

Upon successful completion of the programme students will:

-have the basic theoretical and practical knowledge in the fields of the subject area of Geotechnology and Environmental Engineering

-be able to properly apply the theoretical and practical knowledge acquired during the study period

-be able to cover a wide spectrum of scientific and technical knowledge related to mining and geotechnical projects as well as the sector of environmental reclamation

-have gained the necessary competencies to proceed to their second cycle study.

The hydrogeology is a modern science following the new methods and concepts of the origin, infiltration and storage of groundwater. It combines the science of hydrology and geology, a combination essential in order to derive necessary and useful conclusions on the identification, quantity and quality of groundwater. It contributes decisively to the development and improvement of aquifers with modern methods and technical means• a contribution very important and crucial for the modern man, especially in the era of arid and desertification of the temperate climate zone of southern Europe, where Greece also belongs, and where water is and will be, in the near future even more of a commodity to extinction and thus already considered as a «*protected species*».

On successful completion of this module the learner will be able to:

1. know the relationship between groundwater and surface water and their mutual balance.
2. evaluate how groundwater is stored.
3. understand the laws that govern all types of physical movements of water.
4. point out the role of geological structures and various rocks in the storage and movement of water.
5. analyze the mechanisms of pollution of groundwater and to plan effective measures to reduce pollution and decontamination.
6. to plan effective measures to reduce pollution and decontamination.

3. COURSE CONTENTS

Theory

1. SURFACE HYDROLOGY

Source of the water, the object of Hydrogeology. Hydrological cycle in nature. Hydrological balance. Penetration and infiltration of water into the subsoil.

2. GROUNDWATER STORAGE

Groundwater storage (porosity, role of formations). Distribution of groundwater (aquifers, aquifer categories). Piezometry and level fluctuations as environmental parameters. Overpumping and consequences. Storage coefficient. Formation and types of aquifers. Supply and relief belts. Aquifer systems, karst aquifer systems.

3. GROUNDWATER FLOW

Groundwater flow, law of Darcy, permeability, groundwater action on the porous medium (coprecipitation of aquifers, flowing sand phenomena). The movement of groundwater in porous media, permeability and penetration of water, transmissivity and storage capacity, permeability assessment using practical ways with tracing and grain size analysis, flow networks and applications. Hydraulics of groundwater, permanent and non-permanent flow, calculation of hydraulic parameters in permanent and non-permanent flow.

4. GROUNDWATER QUALITY

Physical and chemical properties of water. Elements of the groundwater quality, sampling, reactions of water - underground (Chemical composition of rainwater, Dissolution, Oxidation - Reduction etc), analysis - using hydrochemical data (hydrochemical maps, hydrochemical diagrams, ionic ratios). Sort groundwater hydrochemical phases etc.).

5. POLLUTION – POLLUTION OF GROUNDWATER

Main sources of quality degradation of groundwater aquifers and water. Dissemination of pollutants. Pollutants - sources and causes of pollution (pollutants, urban pollution, pollution from agriculture, industry, Mining and Quarrying pollution, pollution accidents, etc.). Dissemination of pollutants (Mechanical spreading of pollutants, etc.).

6. PROTECTION FROM POLLUTION – DECONTAMINATION METHODS

Aquifers protection, springs and water intake projects works antifouling contamination and depletion. Vulnerability, protection and buffer zones, control measures, treatment and reduction of pollution decontamination methods and techniques, denitrification. Restoration of aquifers (qualitative and quantitative): removal of pollutants by pumping, exclusion-entrainment, hydraulic trap, washout, chemical methods, artificial enrichment, etc.

Laboratory

- Hydrographic network.
- Water balance calculation.

• Calculation of porosity and permeability.
• Imaging aquifers.
• Diagrams of water quality using appropriate software.

4. TEACHING METHODS - ASSESSMENT

MODE OF DELIVERY	In class rum, Face to face.
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY *Χρήση Τ.Π.Ε. στη Διδασκαλία, στην Εργαστηριακή Εκπαίδευση, στην Επικοινωνία με τους φοιτητές*	Lectures assisting by power point presentations and group comprehension exercises. Educational tours. Contact instructor and students via email.
TEACHING METHODS	

Method description	***Semester Workload***
Classroom lectures	70
Laboratory exercises	55
Autonomous study	15
Total work load hours of lesson	***140***

ASSESSMENT METHODS *Περιγραφή της διαδικασίας αξιολόγησης*	Greek/English Written tests, oral presentations, evaluation laboratory skills through exercises such as: Permeability precipitated water, storage and water balance, water quality diagrams using appropriate software programs. .

5. RESOURCES

-Προτεινόμενη Βιβλιογραφία :
-Συναφή επιστημονικά περιοδικά:

1. Soulios. G. (1996) General Hydrogeology, Volume A, University studio press, Thessaloniki (in Greek).
2. Soulios., G. (2006) General Hydrogeology, Volume D, University studio press, Thessaloniki (in Greek).
3. Voudouris, K. (2009): Hydrogeology Environment, Prentice Hall, Thessaloniki. (in Greek).
4. Stournaras, G. (2007): Water: Environmental dimension and path, Prentice Hall, Thessaloniki (in Greek).
5.Fetter, C.W. (2000). Applied Hydrogeology. Prentice Hall
6.Ingebritsen, S. E., Ward E. Sanford, C. E. Neuzil (2006). Groundwater in Geologic Processes. Cambridge University Press.
7.Nonner, J.C. (2009). Introduction to Hydrogeology. Taylor & Francis.