15 POLLUTION AND PROTECTION OF GROUNDWATER RESOURCES

Teachers: Siarkos I., Asst Professor
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The course covers the following topics:

1. Groundwater and aquifer systems – The threat of groundwater pollution – Pollution sources and types of pollutants – The importance of protecting groundwater resources against pollution.
2. Groundwater quality characteristics – Physical, chemical, and biochemical properties – Physico-chemical processes and their impact on groundwater pollution.
3. Groundwater sampling methods and techniques – Chemical analysis of groundwater – Methods for processing, analyzing, presenting and interpreting the results of hydrochemical analyses.
4. Pollutant transport in groundwater – Mechanisms of pollutant transport (advection, hydrodynamic dispersion, adsorption, degradation, etc.) and their effects – The mathematical formulation of pollutant transport – Analytical and numerical solution methods.
5. Examples of analytical methods for solving pollutant transport problems.
6. Numerical models for simulating pollutant transport – 1 (Basic features, necessary data, and the process of formulating pollutant transport models).
7. Numerical models for simulating pollutant transport – 2 (Use of an interactive tool for simulating pollutant transport).
8. Numerical models for simulating pollutant transport – 3 (Demonstration of pollutant transport simulation software).
9. Groundwater pollution phenomena – 1 (Classification of pollution phenomena from various activities and their risk level – Specialized analysis of various types of pollution).
10. Groundwater pollution phenomena – 2 (The problem of groundwater nitrate contamination: Theoretical approach).
11. Groundwater pollution phenomena – 3 (The problem of groundwater nitrate contamination: Numerical simulation).
12. Protection of groundwater against pollution – Aquifer vulnerability – Protection of abstraction wells (Wellhead Protection Zones, WPZs) – Control and mitigation of pollution sources.
13. Pollution containment and groundwater aquifer restoration – Pump-and-treat systems – Modern remediation methods and alternative techniques.

At the end of the course, the students will be able:

- To identify and categorize the various types of pollutants in groundwater, and assess the level of pollution using appropriate monitoring parameters.
- To understand the necessary procedures for conducting water sampling and hydrochemical analyses, as well as process, present and interpret the results of the analyses.
- To understand the mechanisms that govern the transport of pollutants in groundwater, as well as the significance and role of physico-chemical parameters and processes.
- To apply analytical solutions to solve mass transport problems.
- To use numerical models and specialized software packages to simulate pollutant transport in groundwater.
- To study and analyze pollution phenomena of anthropogenic origin, which are characteristic of groundwater systems.
- To understand the problem of groundwater nitrate contamination and apply theoretical and practical knowledge to study and confront it.
- To design and develop scenarios to mitigate the qualitative degradation of groundwater and propose protection measures against various forms of pollution.
- To implement methods and techniques for the remediation of aquifers, tailored to different categories of pollutants and aquifer systems.

Teaching Mode: 3 hours suggestion-exercises / week