COURSE OF DOCTORAL STUDIES

Course title	Field of science (branch) code	University / Faculty	Institute / Department
Drinking Water Hydrogeochemistry and Water Supply	Natural Sciences (Geology) N 005	Vilnius University / Faculty of Chemistry and Geosciences	Institute of Geosciences / Department of Hydrogeology and Engineering Geology

Study methods	Number of credits allocated	Study methods	Number of credits allocated
Lectures	—	Seminars	—
Individual work	11	Consultations	As needed

Course annotation

Part I — Drinking-water hydrogeochemistry. Origin and evolution of groundwater composition; major and trace constituents, pH, alkalinity, ionic strength, chemical equilibria, mineral dissolution and precipitation, carbonate chemistry, redox processes, sorption and ion exchange. Natural and anthropogenic contaminants (iron, manganese, nitrate, arsenic and other constituents), hydrogeochemical interpretation, water quality monitoring and PHREEQC speciation and reaction modeling.
Part II — Water supply and drinking-water treatment. Water sources, demand, abstraction wells and intakes, water storage and distribution networks. Drinking-water quality standards and risk-based water safety management. Selection and design principles of treatment trains: screening, coagulation–flocculation, sedimentation, granular and mechanical filtration, aeration and oxidation, iron/manganese removal, softening, adsorption, ion exchange, membrane filtration and reverse osmosis, disinfection (chlorine, UV, ozone), residuals management and operational monitoring. Treatment choices are evaluated with reference to raw-water chemistry, removal performance, energy, costs and by-products.

Study methods and individual assignments

Guided independent study of the core and additional literature.

Assessment

Examination consisting of five open-ended questions and a subsequent academic discussion. Questions cover hydrogeochemical processes, interpretation of groundwater composition, drinking-water quality and safety, water supply systems, and selection and critical assessment of drinking-water treatment technologies. Assessment emphasizes scientific reasoning, quantitative understanding and justified engineering choices.

Main study literature

1. World Health Organization (2026). Guidelines for Drinking-water Quality: Fourth Edition Incorporating the First, Second and Third Addenda. WHO. (Link)
2. Massachusetts Institute of Technology (2006). Water and Wastewater Treatment Engineering (1.85), MIT OpenCourseWare: lecture notes, exercises, exams and projects (especially drinking-water treatment lectures). (Link)
3. U.S. Geological Survey (2013). Parkhurst, D. L., & Appelo, C. A. J. Description of Input and Examples for PHREEQC Version 3. USGS Techniques and Methods 6-A43. (Link)
4. U.S. Environmental Protection Agency. Drinking Water Technologies and treatment selection resources. (Link)
5. Sakalauskas, A., Diliūnas, J., Jankauskas, J., & Kisielis, V. (2016). Vandentieka. Vilnius: Technika. (Course reference.)
6. Mokrik, R., & Mažeika, J. (2006). Hydrogeochemistry. Vilnius University Publishing House. (Course reference.)
7. Appelo, C. A. J., & Postma, D. (2005). Geochemistry, Groundwater and Pollution (2nd ed.). CRC Press/Balkema. (Link)

Additional literature

1. Klimas, A. (2003). Geriamojo vandens hidrogeochemija. Vilnius: Vilniaus universiteto leidykla.
2. World Health Organization (2024). Guidelines for Drinking-water Quality: Small Water Supplies. (Link)
3. U.S. Environmental Protection Agency. Operation and Maintenance Resources for Small Drinking Water Systems. (Link)
4. USGS (2025). PHREEQC Version 3: software, example problems and documentation. (Link)

Coordinating lecturer

Vytautas Samalavičius, Associate Professor, Vilnius University.

Approval

Approved by the doctoral committee of Geology (N 005) on 19 October 2026 (5.2.2 E-15600-KT-3953)

Committee Chairman prof. dr. Sigitas Radzevičius