UNIVERSITY OF MISKOLC

FACULTY OF
EARTH AND ENVIRONMENTAL
SCIENCE AND ENGINEERING

WATER QUALITY PROTECTION

Hydrogeology Engineer MSc

2023/24 Semester II.

COURSE COMMUNICATION FOLDER

University of Miskolc
Faculty of Earth and Environmental Science and Engineering
Institute of Water Resources and Environmental Management

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1. Course introduction, teacher, number of lessons, credits

Course Title: Water quality protection **Instructor:** Dr. Péter Szűcs, full professor	**Code:** MFKHT720023 **Responsible department/institute:** Institute of Water Resources and Environmental Management
	Type of course: Compulsory
Position in curriculum (which semester): 2	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 3	**Course:** full time

Course Description:
The students will be familiar with the basic concepts, tasks and purposes of water quality protection. The students will also learn about the contamination transport processes in surface water as well as in groundwater. The students will be prepared to assess and solve different water quality and contamination problems. The students will learn about the different tasks given by the European Water Framework in order to achieve the good status of water resources.
The short curriculum of the subject:
Water as an environmental agent. General tasks and objectives of water quality protection. Water chemistry. Qualification of water samples. Transport processes in water. Vulnerability methods concerning groundwater resources. Remediation methods in case of different contaminations. Water quality models. Current quality status of national water resources. Water quality balance calculations. Natural water purification methods. Practical work: self-made solutions of simple case-study problems.
Compatencies to evolve:
Knowledge:
T1 – It includes knowledge of hydrogeology, water resource management, water quality protection, water treatment, production and waterworks operat
T2 – Extensive knowledge of hydrogeological assessment and monitoring techniques related to watershed approach and considers ecological water demands.
T4 – Have a working knowledge of computer-aided design and analysis
T6 – Knows basic requirements of environmental protection, quality control, consumer protection, product liability, equal access approach, occupational health and safety, technical and economic legislation and engineering ethics.
T7 – Have knowledge of a wide range of problem-solving techniques for research or academic work.
T8 – Have general and specialist management skills to manage complex design work.
Ability:
K1 – Ability to understand the laws and relationships related to the location, movement and quality of groundwater, to apply and put into practice the knowledge acquired, and to use problem-solving techniques.
K2 – Ability to process information from the knowledge frontiers of professional experience of the discipline, ability of problemsolving, and interpreting hydrogeological issues.
K3 – Ability to independently plan and execute tasks related to groundwater exploration, exploitation and well hydraulics at a high professional level.
K6 – Prepared to tackle complex water resource management, water conservation and aquifer protection challenges.
K9 – Ability to model hydrodynamics and transport of groundwater flow systems
K10 – Prepared to effectively apply relevant national and European professional, environmental and conservation legislation
K11 – Ability to implement an ecological approach in line with the EU Water Framework Directive
K12 – Ability to work in compliance with EU legislation, to cooperate with foreign partners to solve the tasks required by the EU Water Framework Directive
K13 – The ability to independently participate in and manage research, development and expertise in the field of hydrogeology
K14 – Ability to lead and participate in complex design work and project management in water management and water supply
K15 – Ability to solve complex problems in a flexible way through creative problem solving, to work in a team, to think and cooperate effectively with representatives of other disciplines (e.g. environment, quality, consumer protection, human health, construction, etc.)
Attitude:
A1 – Open-minded and receptive, active in learning about professional and technological methodological developments in the fields of geosciences and environmental engineering, and in solving geological problems from an engineering perspective
A2 – Open and sensitive to problems and sustainability issues related to the environment and its elements
A3 – Have the motivation to work in a changing work, geographical and cultural contexts

A4 – Deep commitment and professional solidarity
A5 – It is committed to lifelong learning, diversity and values
A6 – Respect and act in accordance with the ethical principles and written rules of work and professional culture, and be able to adhere to them when managing small teams
A7 – Adhere to and comply with health and safety, environmental protection, quality assurance and control requirements.
A8 – Characterised by intuition, consistency and a willingness to learn.
A9 – In addition to his technical and engineering background, he also has an interest in science.
Autonomy and responsibility:
F1 – Act independently and proactively to solve professional problems.
F2 – Have a responsible attitude towards the environment.
F3 – Takes decisions independently and in consultation with other disciplines (mainly legal, economic, energy and environmental), for which it takes responsibility.
F4 – In decisions, takes into account the principles and application of environmental protection, quality, consumer protection, product liability, equal access, health and safety at work, technical, economic and legal regulation and engineering ethics.
F5 – Committed to sustainable natural resource management practices.
F6 – He/she is responsible claims in expert oppinions, professional judgements and for the work carried out under his/her supervision.

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	15 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Liu David, Lipták Béla: Groundwater and Surface Water Pollution. Lewis Publishers, 2000, ISBN 1-56670-511-8, pp. 1-150.
- Merkel Broder, Planer-Friedrich Britta: Groundwater Geochemistry. Springer, 2005, ISBN 3-540-24195-7, pp. 1-200.
- David M. Nielsen, Gillian L. Nielsen: The Essential Handbook of Ground-Water Sampling. CRC Press, 2006, ISBN 1-4200-4278-5, pp 1-300.
- Foulliac A. M., Grath J., Ward R.: Groundwater monitoring (Water quality measurements), 2009
- Page G. W.: Planning for groundwater protection, Orlando Academic press, 1987

2. Course syllabus

Water quality protection
Syllabus
Spring semester
Hydrogeological Engineer MSc, Semester II., Compulsory course

Week		Topic
1	12. Feb.	Groundwater chemistry and quality. The most important facts. Self-purification processes in water. Drinking water regulation
2	19. Feb	Groundwater and Global Change. Groundwater quality and protection – case-study.
3	26. Feb	Transport and heat transport modeling. Geothermal case-studies.
4	4. Mar	Relationship between the water quality (C) and the river discharge (Q). The two possible river models. Streeter and Phelps equations. Regulation the water quality along a river with the help of purification.
5	11. Mar	Groundwater quality improvement program. Case-study
6	18. Mar	Chemical composition of geothermal fluids.
7	25. Mar	Water sampling, isotopes in groundwater.
8	1. Apr	*Holiday*
9	8. Apr	River basin management plans in Europe. Field investigations, electrochemical measurements along the Hejő river (pH, Eh (ORP), EC, TDS, DO).
10	15. Apr	Drinking water in Hungary.
11	22. Apr	Karst hydrogeology, quality aspects.
12	29. Apr	Determination method of macroelements (Ca, Mg, Na, K) and microelements (Fe, Mn etc.).
13	6. May	Determination methods of main anions (bicarbonate, chloride, sulphate).
14	13. May	Plotting of chemical composition.

3. Exam questions

Exam questions 2023 – Water quality protection

1. Please define the water quality. What is the main objective of water quality protection? What kind of self-purification processes can exist in healthy surface water?
2. Please describe the advection, dispersion and diffusion process in groundwater. Please compare the Fick law to the Darcy law. What does the Peclet number express?
3. What are the units of the concentration, the molarity and molality? Please describe the contamination attributes. What kind of geophysical methods can be used for contamination plume delineation?
4. Groundwater and global change. Please describe the key problem issues on global scale related to groundwater resources.
5. Please describe the main objectives of river basin management and river basin management plans. Please describe the idea of the Groundwater Directive. Drinking water regulation in Europe.
6. The main properties of geothermal fluids. The geothermal potential of the Carpathian Basin.
7. Please describe the key issues and relations of groundwater sampling. Major groundwater sampling site types.
8. Karst water quality? The process of karstification? The types of tracers? Please describe the main idea if vulnerability mapping.
9. Drinking water in Hungary. Challenges in drinking water quality. Quality requirements. Problems related to water treatment and water distribution. Water safety planning.
10. Determination method of macro elements (Ca, Mg, Na, K) and micro elements (Fe, Mn etc.).
11. Determination methods of main anions (bicarbonate, chloride, sulfate).
12. Field investigations, electrochemical measurements (pH, Eh (ORP), EC, TDS, DO).
13. Plotting of chemical compositions.
14. Relationship between the water quality (C) and the river discharge (Q). Please define the two possible river models.
15. Please give the Streeter and Phelps equations. How can you regulate the water quality along a river with the help of purification?
16. What is the main objective of a drinking water quality improvement program? Please give some case-study examples concerning situations and solutions.