GROUNDWATER PROSPECTING AND MANAGEMENT

Hydrogeologist Engineer MSc mesterszak

2018/19 II. félév

TANTÁRGYI KOMMUNIKÁCIÓS DOSSZIÉ

Miskolci Egyetem
Műszaki Földtudományi Kar
Környezetgazdálkodási Intézet

Tartalomjegyzék

1. Tantárgyleírás, tárgyjegyző, óraszám, kreditérték

Course Title: Groundwater prospecting, water resources management **Instructor:** Andrea Tóth Dr. Kolencsikné, assistant lecturer	**Code:** MFKHT720021 **Responsible department/institute:** Institute of Environmental Management Type of course: Compulsory
Position in curriculum (which semester): 2	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 4	**Course:** full time

Course Description:

The course gives an overview of the different GW occurrences, and of properties of aquifers. The students gain a basic knowledge about the principles and main problems of GW management. The students will be familiar with the different methods used in GW prospecting. They will learn the pros and contras, applicability limits of them. The course gives a practical summary and evaluation of the field and laboratory tests, surface (geophysical methods, remote sensing) and direct (CPT, drilling, well instruction) methods of GW exploration. The students will get the fundamentals to be able to plan a complex GW prospecting project, and the protection of GW resources.

The short curriculum of the subject:

Basics of GW management. Types and determination of GW resources. Theory of GW protection. Practical aspects of GW protection, determination of well-head protection areas. Methodology and principles of groundwater prospecting. Geological, geotechnical, geophysical and remote sensing methods used in prospecting groundwater resources. Practical work: self-made solutions of simple case-study problems.

Compatencies to evolve:

Knowledge: T1, T2, T4, T7, T8

Ability: K1, K2, K3, K6, K10, K11, K12, K13, K14, K15

Attitude: A1, A2, A3, A4, A5, A6, A8, A9

Autonomy and responsibility: F1, F2, F3, F4, F5, F6

Assessment and grading:

Students will be assessed with using the following elements.

During the semester for the signature:

Attendance:	15 %
Short quizzes	10 %
Practical work	75 %

Final exam 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:

- Fetter, C.W. (1988): Applied Hydrology, Merill, Carmel, California
- Freeze, R.A. – Cherry, J.A. (1979): Groundwater, Prentice-Hall, Englewood Cliffs
- Nielsen D.M. (2005): Practical handbook of environmental site characterization and groundwater monitoring, CRC Press, ISBN 9781566705899
- Moore, J.E. (2017): Field hydrogeology, CRC Press
- Keys W. S. (1996): A practical guide to borehole geophysics in environmental investigations, CRC Press

2. TANTÁRGYTEMATIKA

Groundwater prospecting and management
Tantárgytematika (ÜTEMTERV)
Aktuális tanév tavaszi félév
Hidrogeológus mérnök mesterszak MSc, 2. félév, törzsanyagos tárgy

Hét	Előadás
2019.02.12.	Summary of basic hydrogeology, physical properties and principles, properties of aquifers
2019.02.19.	Groundwater and the hydrologic cycle – soil moisture and groundwater recharge
2019.02.26.	Water balance
2019.03.05.	Principles of GW flow, gw recharge, regional groundwater flow
2019.03.12.	Groundwater development and management, groundwater resource evaluation
2019.03.19.	Global issues and problems of water management
2019.03.26.	Planning field investigation
2019.04.02.	Remote sensing
2019.04.09.	Surface Geophysical methods
2019.04.16.	Subsurface investigations
2019.04.23.	Borehole/Well logging
2019.04.30.	Aquisition and interpretation of water level data, methods and procedures for defining aquifer parameters
2019.05.07.	Basics of Groundwater protection
2019.05.14.	Tracers in hydrogeology

Hét	Gyakorlat
2019.02.12.	Basic calculations related to physical properties
2019.02.19.	Calculations related to the hydrologic cycle
2019.02.26.	Calculations related to water budget
2019.03.05.	Calculations of flow gradient, flow velocity, hydraulic head, aquifer pressure
2019.03.12.	Calculation of combined cone of depression for a group of wells
2019.03.19.	Interpretation of potential and flow fileds using IGW-interactive GW model

2019.03.26.	Surfer application1: calculation of static yield, grid operators
2019.04.02.	Surfer application2: interpolations, base maps, post maps, contour maps
2019.04.09.	Surfer application 3: Visualization of combined cone of depression
2019.04.16.	Excercise in Remote sensing
2019.04.23.	Evaluation of pumping tests using Aquifertest

3) MINTA ZÁRTHELYI

Groundwater prospecting and management
final test for signature
max. 36 points, accepted >21 points

1. (**3 point**) Hydraulic conductivity calculation
2. (**3 point**) Aquifer storage calculation
3. (**6 point**) GW flow direction, flow gradient and flow velocity calculation
4. (**3 point**) Static yield (resource) calculation
5. (**4 point**) Evaporation rate calculation
6. (**5 point**) Water balance for surface water
7. (**6 point**) Vertical hydraulic gradient, flow direction, pressure and total head
8. (**3 point**) Aquifer compressibility calculation
9. (**3 point**) Water balance for groundwater

4) ÍRÁSBELI VIZSGA KÉRDÉSSOR

Groundwater prospecting and management
questions for final written test

- Confined and unconfined aquifer (draw)
- Aquifer and aquitard
- The main aquifer materials (geological formations)
- Porous, karstic and fractured aquifers
- Total and effective porosity, primary and secondary porosity
- specific retention
- Darcy's law
- Specific yield
- Specific storage
- permeability, transmissivity
- compressibility, stress's types, effective stress, normal stress, stress changes during pumping
- Hydraulic gradient of the groundwater flow
- Hydraulic head (total head, or potentiometric head), and pressure head
- Potential energy
- Hydraulic pressure
- Artesian well
- Local to regional groundwater flow system
- Recharge and discharge areas
- P-z graph (draw)
- Precipitation, transpiration, evaporation, humidity, dew point, surface runoff, infiltration, recharge, soil storage
- The elements of the hydrologic cycle of Earth
- Capillarity
- Inputs and outputs of the groundwater balance
- Static yield, dynamic yield, exchange rate
- type of groundwater resources, recharge, discharge
- Water sources of confined aquifer during pumping
- Water sources of unconfined aquifer during pumping
- water resource management balance
- ecological water demand, guaranteed flow
- water management, suistanable yield concept
- types of water utilization
- The phenomena of dryland salinity
- Sustainability in water management
- Main problems in groundwater management (only a list)
- The reason of increasing surface runoff and its impacts
- The reason of increasing flood events
- Aquifer depletion and its consequences
- The phenomena of saline intrusion into fresh aquifers (draw)
- Point pollution sources (list)
- Diffuse pollution sources (list)
- What main issues affect the planning of groundwater protection
- Two basic idea of groundwater protection
- The planning principles of qualitative protection of a bank filtered aquifer

- The idea of protection zones based on travel times
- Vulnerable groundwater resource
- The meaning of passive surface geophysical method
- The meaning of active surface geophysical method
- Definition of apparent resistivity
- What factor decrease the measured resistivity?
- The basic of DC resisitivity method
- The basic of Magnetotelluric method
- The basic of Induced polarization method
- The basic of self potential method
- Current and potential field in homogenous system (draw)
- The difference between Wenner and Schlumberger electrode configuration (draw)
- the difference between lateral and sounding surface resistivity survey
- Disadvantages of surface resistivity method
- Sources of Induced Polarization effects underground (list)
- Skin depth
- Basic idea of ground penetrating radar
- Basic idea of seismic refraction method
- Basic idea of gravimetry method
- Logging units (what tools needed for borehole logging)
- Types of logs (list)
- Resisitivity zones around a borehole (draw)
- The basics of natural gamma, gamma-gamma and neutron logging
- The porosity logs
- The basic idea of caliper logging
- The goal of subsurface exploration
- Advantages of machine drilling
- The method of wash boring
- Left and right type of washing
- Geologic logging during drilling
- Hand completed wells
- What is the well screening
- The main well types
- The goal of pumping test
- Type of pumping tests
- Result of a recovery test (graph)
- Result of a step drawdown test (graph)
- Specific capacity of a well in confined aquifer (graph)
- Specific capacity of a well in unconfined aquifer (graph)
- Important features of a pump (list)
- Advantages and limitations of remote sensing
- Possible platforms in remote sensing (list)
- Influencing factors of reflection of EM waves on the earth surface
- The steps of satellite image processing
- Application of remote sensing in hydrogeology

5) ÍRÁSBELI VIZSGA TÉTELSOR

Groundwater prospecting and management questions for final oral exam

1. Elements of the hydrologic cycle, the recharge (evapotranspiration, precipitation, surface runoff, infiltration process, recharge, seasonal and other impacts for shallow groundwater)

2. Aquifer properties (hydraulic conductivity, transmissivity, specific yield and storage, porosity, determination of hydraulic conductivity)

3. Basics of GW flow (hydraulic gradient, Darcy's flow velocity, potential energy, pressure head, total head, hydrostatic pressure, pressure-depth relationship)

4. Theory of hydrogeological unit basin (Tóth J.) (flow and equipotential lines, recharge- and discharge area, scale of groundwater systems)

5. Sustainable yield concept in GW management (static and dynamic yield in case of surface - and groundwater, exchange rate, types of water uses, GW dependent ecosystems, Surface water-gw interaction)

6. Storage and specific yield, GW abstraction from unconfined and confined aquifers, water budget

7. The problems in GW resource management (changes in recharge, aquifer depletion, the origins of groundwater salinization, land subsidence, pollution)

8. Groundwater protection (basic ideas of protection, problems in protection, protection zones, known watersheds, travel times etc)

9. Application of surface geophysical methods (resistivity methods, DC, IP, GPR, MT, seismic m., gravity m., advantages, disadvantages, which method for which type of exploration, needed tools, the results)

10. Application of borehole logging in GW exploration (methods in borehole, resistivity logs radiation logs, penetration depths, interpretation, aquifer identification)

11. Application of well logging (which type of methods can be used in a cased well, which information is given, flow meter, cement bond logs, interpretation of results)

12. Subsurface exploration (types of drilling, investigation methods, well construction, well types, well testing)

13. Remote sensing in GW exploration

14. Tracers and tracer experiments in GW exploration