Syllabuses

MS in Hydrogeology Engineering

Subject	Code
Computer science for engineers	GEMAK713M
Numerical Methods and Optimization	GEMAK712M
Environmental Geology	MFFAT710008
Geodesy, spatial informatics	MFGGT710002
Mineralogy – geochemistry	MFFAT710005
Soil mechanics	MFKHT710008
Gradual research seminar	MFFAT710006
Fluid mechanics	MFKGT710005
Hydrogeology	MFKHT710017
Groundwater prospect.,water res. management	MFKHT720021
Applied and engineering hydrology	MFKHT720022
Water quality protection	MFKHT720023
Geophysics of exploration for water	MFGFT720024
Geotechnical engineering	MFKHT720025
Water chemistry	AKKEM6005
Hydrogeology of Hungary	MFKHT720026
Waterworks, water supply	MFKHT720027
GW flow and contaminant transport mod.	MFKHT720028
Quality Management	GTVVE7002MA
Geothermics	MFKGT730021
Watermining	MFKHT740021
Hydrogeological interpretation	MFKHT730024
Drilling, Deep Drilling	MFKOT730029
Water and waste water purification	MFEET73001A
Environmental Risk Asses.and Remediation	MFKHT730026
Environmental Geotechnics	MFKHT730030
Optional: Surface for windows hands-on training..	MFKHT73005
Numerical methods in geotechnics	MFKHT730022
Optional: Remote sensing	MFFTT730032
Optional: Wellfield and gw resources prot	MFKHT730033
Safety tech. and labour safety	MFKOT740010
Strategic Management	GVVE7041MA

Miskolc, 2019. február 01.

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Dr. Szűcs Péter
szakfelelős

Course Title: Computer science for engineers **Instructor:** Dr. Józsefné Mészáros, honorary associate professor	**Code:** GEMAK713MA **Responsible department/institute:** Department of Applied Mathematics Type of course: Compulsory
Position in curriculum (which semester): 1	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 0+2	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 2	**Course:** full time

Course Description:

Extend the application of the computer as engineering training aids for numerical and symbolic computation.

Programming and using of MATLAB environment (desktop): opration with matrices, elements of linear algebra, plot of one, two or three dimensional functions, printing, control statements, handle graphics and user interface.

The short curriculum of the subject:

Object-oriented programming. Design of programming. Computer aided solution plan for chosen problems. Numerical kernel: numerical methods, input-output. Using of files. User interface with karakters and graphics. Writing, testing an documentation for programs. Online and printed description of programs. Help and demo in programs. Printability for the results.

Basic concepts, objects of Maple programming language: definition and using of assign, variable, set, array, function. The Maple as programming language: using of array, conditional and loop statement. Definition and application of procedure. Main algorithm in Maple. Graphics of Maple: plot and plot3d, animation statements. Using of files, applications.

Compatencies to evolve: T4, T7

Knowledge:

Ability: K15

Attitude:A9

Autonomy and responsibility:

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:

Text books:

- Attaway S.: MATLAB: A practical introduction to programming, and problem solving, College of Engineering, Boston University, 2009.
- Dukkipati R. V.: MATLAB: An introduction with applications, 2008.
- Moler C. D.: Numerical computing with MATLAB, The MathWorks Inc., 2004.
- Stoyan G. (szerk.): *MATLAB*, Typotex, 2005.

Other references:

- The MATH WORKS Inc., Release 13 Product Family Documentation Set, 2002.

Course Title: Numerical Methods and Optimization **Instructor:** Dr. Józsefné Mészáros, honorary associate professor	**Code:** GEMAK712MA **Responsible department/institute:** Department of Applied Mathematics Type of course: Compulsory
Position in curriculum (which semester): 1	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 2	**Course:** full time

Course Description:
Acquired store of learning:

Study goals: Upon completing the course, students shall understand the relation between engineering and mathematics; comprehend important concept of solution methods using both analytical and numerical techniques when the problems can be formulated using differential equations, system of linear equations and system of nonlinear equations. In addition, students shall be able to apply the optimization techniques to various engineering problems.

Course content

Extrema of functions. Unconstrained and constrained optimization. Convex optimization, Minimization of functions with one variable (golden section, parabola method). Minimization of multivariable functions (Nelder-Mead, Newton, modified Newton, quasi-Newton, minimization with line search). Methods of penalty functions. Multiaided and multicriteria decision problems (Pareto effitient solutions). Linear programming. About Soft Computing (SC) methods: fuzzy systems, genetic algorithms, neural network.
Numerical solutions of ordinary diffrential equations and system of equations:
Runge-Kutta, predictor-corrector, finite differences.
Compatencies to evolve:
Knowledge: T5, T7
Ability:K15
Attitude:A9
Autonomy and responsibility:

Assessment and grading:
During the semester the following tasks should be completed: one test and a computerized homework

Grading Limits:
> 80%: excellent,
70-79%: good,
60-69%: medium,
50-59%: satisfactory,
< 50%: unsatisfactory.

Compulsory or recommended literature resources:

- Égertné, M. É., Kálovics, F., Mészáros, G.: Numerical Analysis I.-II. (Lecture notes), Miskolci Egyetemi Kiadó (1992), 1-175.
- R. Fletcher: Practical Methods of Optimization, John Wiley &Sons, 2000.
- P. E. Gill, W. Murray, M. H. Wright: Practical Optimization, Academic Press, 1981.
- J. Nocedal, S. J. Wright: Numerical Optimization, Springer, 2000.
- Galántai Aurél-Jeney András: Numerikus Módszerek; Miskolci Egyetemi Kiadó, 1997.
- Galántai Aurél: Optimalizálási módszerek; Miskolci Egyetemi Kiadó, 2004.

Course Title: Environmental Geology **Instructor:** Dr. Viktor Mádai, associate professor	**Code:** MFFTT10008 **Responsible department/institute:** Department of Applied Mathematics Type of course: Compulsory
Position in curriculum (which semester): 1	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination/ practical mark / other):** examination
Credits: 4	**Course:** full time

Course Description:
Acquired store of learning:

The main objective of the course is to make the students familiar with the effects of geological medium on the state and changes of the environment, and prepare them for revealing the geological background of environmental problems as well as mitigating or minimizing these problems.

Course content
System approach in geology, changes in the four main systems of the Earth. The objects, methods and legal background of environmental geology. Environmental minerals, their characteristics and role in causing and mitigating of environmental problems. Geological hazards (volcanism, earthquakes, mass movements). The role of geological medium in the anthropogenic contamination and pollution (processes of environmental geochemistry, interactions between soil, rocks and contamination, geological conditions effecting on the spreading of contamination). Geological and geochemical concerns of the effects of mining on the environment. Geological background of the radioactive waste disposal. Geology in nature protection. Geological tasks in the environmental assessment.
Practical work: self-made solutions of simple case-study problems.
Compatencies to evolve:
Knowledge: T1
Ability:K1, K2
Attitude: -
Autonomy and responsibility: -

Assessment and grading:
Handing in the half year task in an exceptable format and level in time (last week of the semester), writing two tests at least on the minimum level of 51%. Failed tests are rewritable on the last week of the semester. Attendance of lectures and seminars are compulsory. Missing more than three occasions from lectures or seminars cause deny of signature.

Grading Limits:
Evaluation of the knowledge happens in 100% by the result of the exam. Reaching the 80% of the minimum questions , which is a compulsory constrain to start the oral or written exam.
Oral exam: 0 - 50%: 1, 50 – 60%: 2, 60 – 70%: 3, 70 – 90%: 4, 90 – 100%: 5

Compulsory or recommended literature resources:

- *Edgar, Spencer;Reichard, J S;Reichard, J*: **Environmental Geology**, McGraw-Hill, 2009,
- *Keller, E A*: **Introduction to Environmental Geology**, Prentice Hall, 2011,
- *Erickson, J.:* **Environmental Geology: Facing the Challenges of Our Changing Earth (Living Earth)** Amazon com,2002
- *Foley,Duncan*: **Investigations in environmental geology**, Prentice Hall, Upper Saddle River N.J, 2009,
- *Holland, H D.*: **Treatise on geochemistry**, Elsevier, New York NY, 2003
- *Keith,S..*: **Environmental hazards**, Routledge,, Abingdon, Oxon ;;New York :, 2008,
- *Knödel,Klaus*: **Environmental geology : handbook of field methods and case studies**, Springer, Berlin ;;New York, 2007,

- *Montgomery, C W*: **Environmental Geology**, McGraw-Hill, 2010,
- *Patnaik, P.*: **Handbook of environmental analysis: chemical pollutants in air, water, soil, and solid wastes**, Taylor and Francis, 2009,
- *Bell F. G.*: **Geological Hazards: their assessment, avoidance and mitigation.** E & FN Spon, London, 1999
- *Lundgren L. W.*: **Environmental Geology.** Prentice-Hall Inernational, London, 1999.

Course Title: Geodesy, spatial informatics **Instructor:** Dr. Gábor Bartha professor emeritus	**Code:** MFGGT710002 **Responsible department/institute:** Institute of Geophysics and Geoinformatics
	Type of course: Compulsory
Position in curriculum (which semester): 1	**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 **Program:** Hydrogeological Engineering MSc

Course description:

The students will acquire the principles of modern geomatics, its measuring methods and the application of IT in the subject. They will be prepared to apply the modern measuring techniques, the remote data-acquiring methods and use them to solve practical problems. They will learn the application fields of geo-informatics and GIS programs. The students will be competent in the application of modern geodetic technology and geo-informatics in their field. The students enable to process their professional data and organize them into geo-information databases.

The short curriculum of the subject:

Coordinate Systems in geodesy. Geometric shape and gravitational field of Earth. Projections and mapping. Hungarian projections and mapping. Modern measuring techniques in Geodesy: Photogrammetry, Remote Sensing, GPS, Inertial Measurements, SAR technology for promoting surveying tasks in the related special fields. Geo-objects and geo-models. Raster and vector models. Data-storing techniques. Database-modelling in geo-informatics. Thematical data and their storage problems. GIS packages. Digitalization, analytical problems, knowledge based systems in GIS environment.

Practical work: self-made solutions of simple case-study problems.

Competencies to evolve:

Knowledge: T7

Ability: K2

Attitude: A2

Autonomy and responsibility: F6

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
85 -100%	5 (excellent)
70 – 84%	4 (good)
55 - 69%	3 satisfactory)
40 - 54%	2 (pass)
0 - 39%	1 (failed)

Compulsory or recommended literature resources:

- Quest: Geodesy Tutorial;
- Vanicek, P.: Geodesy;
- Burkard, R. K.: Geodesy for the Layman;
- Gábor Bartha: Geoinformation Master Course. University of Miskolc, 2014.
- István Havasi - Gábor Bartha: Introduction to GIS, Introduction to Geoinformatics (pp. 10.5)

(Gábor Bartha), Satellite Global Positioning Systems (pp. 67) (István Havasi). angol nyelvű digitális tankönyv: http://digitalisegyetem.uni-miskolc.hu, Miskolci Egyetem. TÁMOP 4.1.2.-08/1/A-2009-0033 projekt, 2011;

- Short, N.: The Remote Sensing Tutorial.

Course Title: Mineralogy and geochemistry **Responsible Instructor:** Sándor Szakáll, associate professor	**Code:** MFFAT710005 **Responsible department/institute:** Department of Geology and Mineral Resources
	Type of course: Compulsory
Position in curriculum (which semester):1st	**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: Students will get the knowledge of the principals of the distribution of chemical element in the Earth. They will also know the most important thermodynamic processes concerning solid materials, the geochemical classification of elements, the geochemical aspects of the genesis of the most important minerals and mineral assemblages. The geochemistry of isotopes, which explores the chemical evolution of the Earth will also be introduced, as well as the geochemical characteristics of water, organic matter, magmatic, sedimentary and metamorphic rocks by which we can describe the mineral-and rock-forming processes in the crust and mantle.

Competencies to evolve:

Knowledge: T7

Ability: K1, K2

Attitude: A1, A2, A9

Autonomy and responsibility: F2, F5

The short curriculum of the subject: Abundance of chemical elements. Meteorites. Geochemical classification of elements. Chemical composition of Earth. Chemical composition of minerals. Genetic characteristics of mineral parageneses. Isotopes and the Periodic Table. Radioactivity and geochronology. Stable isotopes and geology. Short thermodynamics. Water chemistry. Characteristics of natural water. Geochemistry of soils. Organic geochemistry. Organic geochemistry of freshwater and seawater. Geochemistry of sedimentary rocks. Chemical weathering. Geochemistry of igneous and metamorphic rocks.

Assessment and grading:

The final grade will consist of two part. During the semester two midterm tests are written. The average of them will be the 50% of the final grade. The rest 50% is for the final exam. The total (100%) of them is graded as:

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:

Dill H.G. (2010): The „chessboard" classification schene of mineral deposits. Elsevier, 2010.

Albared, F. (2005): Geochemistry. An introduction. Cambridge Univ. Press.

D. Sarkar, R. Datta, R. Hanningan: Concepts, and applications in environmental geochemistry, Elsevier 2007.

John W. Anthony, Richard A. Bideaux, Kenneth W. Bladh, and Monte C. Nichols, Eds. (2003): Handbook of Mineralogy. Mineralogical Society of America.

Brownlow, A. H. (1996): Geochemistry. Prentice Hall, New Jersey.

Petruk W.: Applied mineralogy int he mining industry, Elsevier, 2000

Rankama, K., Sahama, Th.G.: Geochemistry. Univ. Chicago Press.

White, William M. (2013) Geochemistry. Wiley-Blackwell, 668 p

Raju, R. Dhana (2009) Handbook of Geochemistry: Techniques and Applications in Mineral Exploration. Geological Society of India, 520 p.

Albarede, Francis (2003) Geochemistry: An Introduction. Cambridge University Press, 248 p.

Course Title: Soil mechanics **Instructor:** Dr. Tamás Madarász, associate professor	**Code:**MFKHT710008 **Responsible department/institute:** Deparment of Hydrogeology and Engineering Geology
	Type of course:Compulsory
Position in curriculum (which semester): 1	**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 students will be familiar with the basic concepts of soil mechanics. They will learn about the determination soil parameters, soil classification. After a short review the students will study the main topics of applied soil mechanics, in the interest of being able to manage interactions between buildings/objects and subsoil, to solve, handle or expertise occurring problems (construction, building, damages).

The short curriculum of the subject:

Bearing capacity of soils, foundations. Settlement and consolidation of foundations, solution to problems of stabilitay and settlement. Foundations and embankments over soft soil and peat. Determination of earth pressure, active and passive earth pressure. Stability analysis of natural and artificial slopes, factors in slope designe, reconstruction of landslides. Retaining walls, gravity walls, reinforced earth walls, embedded walls. Geotechnical aspects of deep foundations, excavations and hydraulic engineering. Geotechnical problems of open pit mining. Geosynthetics. Geotechnical objects of environmental protection. Engineering geological mapping.

Practical work: self-made solutions of simple case-study problems.

Compatencies to evolve:

Knowledge: T3, T4, T7

Ability: K7, K12, K13, K15

Attitude: A2, A9

Autonomy and responsibility: F1, F2, F5, F6

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:

- Atkinson, J.: The Mechanics of Soils and Foundations. Taylor and Francis, London, 2007.
- Jonathan Knappett, R.F. Craig: Craig's Soil Mechanics, Eighth Edition, 2012.
- Braja M. D.: Advanced soil mechanics, Spon Press, 2008
- Smith G. N., Smith I. Smith G. N.: Elements of soil mechanics, Wiley-Blackwell, 1998
- Smoltczyk, U. ed.: Geotechnical Enineering Handbook., Ernst & Sohn, Berlin, 2003.
- Mitchell, J. K., Soga, K.: Fundamentals of Soil Behaviour, John Wiley, 2005

Course Title: Gradual research seminar **Instructor:** Dr. Ferenc Mádai, associate professor, institute head	**Code:** MFFAT720007 **Responsible department/institute:** Institute of Mineralogy and Geology
	Type of course: Compulsory
Position in curriculum (which semester): 1	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 0+2	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 2	**Course:** full time

Acquired store of learning:

Study goals: To introduce the methods of information gathering and evaluation, formal and ethic requirements of scientific communication, rules for preparation of oral and poster presentations. During the course these general requirements are actualized to the field of earth science and engineering. Examples and excercises will use English publications and text materials.

Course content: Editorial and formal requirements of scientific publications. Planning of the concept and structure of a scientific publication, making an outline, development of a concept map. Usage of references, reference styles. Etics of scientific writing: how to avoid plagiarism, usage of citations. Information sources provided by the Central Library: hard copy, catalogue search, electronic resources. Usage of electronic information resources: search options, simple and combined search, electronic libraries. Data visualization: graphs, figures, tables. The art of presentation: preparation for an oral contribution. The art of presentation: preparation of a poster.

Education method: Completion of a 3-4 pages paper on a specified topic from petroleum geoscience. It should be a literature summary with at least one table and one figure. The paper should fulfil all formal requirements of a scientific paper. Completion of a 5-minutes presentation on the above mentioned specified topic. It should be presented for the class audience.

Competencies to evolve:

T1, T5, T8, T12, K1, K2, K3, K5, K6, K7, K8, K9, K10, K11, A2, A3, A4, A5, A6, A7, A8, A9, F1, F2, F3, F4, F5

Assessment and grading:

During the semester the following tasks should be completed: short presentation of the selected topic, outline and references (20%), elaboration of the concept map of the article (20%), submission of first draft (15%), submission of the final text (20%), ppt presentation of the topic in 10 minutes (25%).

Grading limits:

>80%: excellent,
70-79%: good,
60-69%: medium,
50-59%: satisfactory,
<50%: unsatisfactory.

Compulsory or recommended literature resources:

- L. C. Perelman, J. Paradis, and E. Barrett: The Mayfield Handbook of Technical and Scientific Writing (McGraw-Hill, 2001).
- G. J. Alred, C. T. Brusaw, and W. E. Oliu: Handbook of Technical Writing, (St. Martin's, New York, 2003).
- Hagan P; Mort P: Report writing guideline for mining entógineers. Mining Education Australia, 2014.
- Chun-houh Chen, Wolfgang Härdle, Antony Unwin (eds.) Handbook of Data Visualization (Springer, 2008).
- MEA Report writing guide. https://www.engineering.unsw.edu.au/mining-engineering/sites/mine/files/publications/MEA_ReportWritingGuide_eBook_2018ed.pdf
- ISO 690-2: Information and documentation - Bibliographic references.

Course Title: Fluid mechanics **Instructor:** Dr. Anikó Tóth, associate professor	**Code:** MFKGT710005 **Responsible department/institute:** Petroleum Engineering Department
	Type of course: Compulsory
Position in curriculum (which semester): 1	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 3	**Course:** full time

Course Description:

Basic knowledge to learn Hydrogeology, Applied Hydrology, Water supply, Hydrodynamical modelling etc. The most important elements of fluid mechanics are fitted into the frame of the transport theory. Fundamentals of fluid mechanics and the flow through porous media will be learned at the level of direct engineering applications.

The short curriculum of the subject:

Fundamentals of kinematics. Balance equations of mass, momentum and energy. Euler's equation, Bernoulli's equation. Viscous fluids. Navier-Stokes equation. Dynamical similarity of flows. Laminar flow in pipes. Elementary boundary layer theory. Turbulence, mixing length theory. Turbulent flow in pipes. Head losses. Multiple-pipe networks. Fundamentals of flow in turbomachines. Flow through porous media. Complex variables for two-dimensional flow.

Compatencies to evolve:

Knowledge: T4, T5

Ability: K1, K2, K9, K13

Attitude: A9

Autonomy and responsibility: F6

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:

- Bobok E.: Fluid Mechanics for Petroleum Engineers. Elsevier, Amsterdam, New York, Tokyo, 1993.
- Currie, Iain G., Currie I. G.: Fundamental mechanics of fluids, Mechanical engineering, 2002
- Fox, W. Mc. Donald, Pritchett: Introduction to Fluid Mechanics. J. Wiley, New York, 2003
- Massey, B.: Mechanics of Fluids. Taylor and Francis, London, New York 2005.
- Streeter, Wylie: Fluid Dynamics. Mc Graw Hill, New York 1990.

Course Title: Hydrogeology **Instructor:** Dr. Péter Szűcs, full professor	**Code:** MFKHT710017 **Responsible department/institute:** Institute of Environmental Management Type of course: Compulsory
Position in curriculum (which semester): 1	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+2	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 5	**Course:** full time

Course Description:

The students will be familiar with the basic concepts of modern hydrogeology as well as field hydrogeology. The students will learn about the relationships of rocks and groundwater, and about the phenomena of groundwater flow through the pores and fractures. The students will be able to handle and solve basic problems in hydrogeology and contamination transport. The main relationships of well hydraulics concerning steady-state and transient problems are also discussed. The students will be able to calculate the discharge value, the depression curve and the velocity distribution of an operating well or a group of wells. The students will be able to carry out field pumping tests, and they will be able to interpret the obtained results effectively.

The short curriculum of the subject:

The main properties and quality aspects of groundwater. Classification of groundwater resources. Storage and hydraulic properties. Darcy-law, flow and seepage equations. Temperature properties under the surface. Shallow and deep groundwater. Karst water, river bank filtered water resources. Relationship between groundwater and surface water. Springs. Flow systems under the surface. Groundwater as a geologic agent. Determination of hydraulic conductivity. Transport processes in groundwater. Basics of well hydraulics. Calculation of well discharge, determination of depression curve and velocity distribution around wells. Group of wells. Pumping tests and their interpretation. Complex interpretation of groundwater data. Practical work: self-made solutions of simple casestudy problems.

Compatencies to evolve:

Knowledge: T1, T2, T4, T5, T6, T7, T8

Ability: K1, K2, K3, K4, K6, K8, K9, K10, K11, K12, K13, K14, K15

Attitude: A1, A2, A3, A4, A5, A6, A7, A8, A9

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

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:

- Péter Szűcs: Hydrogeology. Course materail for Geothermal engineers. University of Miskolc, 2011.
- David Daming: Introduction to Hydrogeology, McGraw-Hill Higher Education, 2002.
- P. F. Hudak: Principles of Hyrogeology. Lewis Publishers, 1999.

- S. E. Ingebritsen, W. E. Sanford: Groundwater in Geologic Processes. Cabridge University Press, 1998.
- Kruseman G.P. and Ridder N.A: Analysis and Evaluation of Pumping Test Data, ILRI publication, Wageningen, Netherlamds, 1990, pp. 1-377.
- Waterloo Hydrogeologic: AquiferTest Pro, User's Manual, 2005, pp- 1-270.
- Neven Kresic: Quantitative Solutions in Hydrogeology and Groundwater Modeling. Lewis Publishers, 1997.

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

Course Title: Applied and engineering hydrology **Instructor:** András Szöllősi-Nagy, full professor	**Code:** MFKHT720022 **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): 1+1	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 2	**Course:** full time

Course Description:

To introduce the measurement methods and principles of hydraulic characteristics of surface and subsurface waters; to familiarize the students with its newest tools and the modern processing methods of the measurement data. Tools, methods and organizations of prevention of water damage. To prepare student how to solve basic hydraulic measurement problems.

The short curriculum of the subject:

Overview of hydrometeorology basics. Importance of precipitation in the hydrological cycle. Determination of precipitation data characteristics, precipitation forecast systems. Flowing and stagnant waters. The place of surface and subsurface flowing waters in the hydrological cycle. Measurement of water level, water depth and water velocity in flowing waters, calculation methods of water yield. Sediment measurements and calculating methods on flowing and stagnant waters. Effects of ice phenomena on water levels and on objects on shore. Place of evaporation in the hydrological cycle. Evaporation determination methods. Hydrology of storage. Surface drainage, river training, flood control, excess surface waters. Procession of hydrological data, hydrological calculations. Publication of processed data.

Compatencies to evolve:

Knowledge: T1, T2, T3, T5, T7

Ability: K1, K2, K3, K6, K9, K10, K11, K12, K13, K14, K15

Attitude: A1, A3, A4

Autonomy and responsibility: F1, F5, F6

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:

- Almássy E. (1977, 1988): Hidrológia-hidrográfia, Tankönyvkiadó.
- Brooks, K. N. – Ffolliott, P. F. – Gregersen, H. M. – Thames, J. L. (1996): Hydrogeology and the management of watersheds. Iowa State University Press/AMES
- Chow, V., Maidment, D., Mays, L.:Applied hydrology, 1988
- Eslamian, S.: Handbook of engineering hydrology1: Fundamentals and applications, Taylor and Francis, 2014
- Ojha, C. S. P., Brendtsson, R., Bhunya P.: Engineering hydrology, Oxford University Press, 2008

Course Title: Water quality protection **Instructor:** Dr. Péter Szűcs, full professor	**Code:** MFKHT720023 **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): 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, T2, T4, T6, T7, T8

Ability: K1, K2, K3, K6, K9, K10, K11, K12, K13, K14, K15

Attitude: A1, A2, A3, A4, A5, A6, A7, A8, A9

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

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

Course Title: Geophysics of exploration for water **Instructors:** Péter Tamás Vass Dr., associate professor, Norbert Péter Szabó Dr., associate professor	**Code:** MFGFT720024 **Responsible department/institute:** Department of Geophysics **Type of course:** Compulsory
Position in curriculum (which semester): 2	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+2	**Type of Assessment (examination/ practical mark / other):** examination
Credits: 5	**Course:** full time **Program:** Hydrogeological Engineering MSc

Course Description:
Students will be provided with geophysical skills applied in the exploration for water. The subject reviews the relation and system of physical, geophysical, hydrogeological and geometrical parameters determined by different geophysical methods. In the seminars students can acquire the basic processing, interpretation and management methods of geophysical data sets and come to know how to use some relevant softwares.
The short curriculum of the subject:
Determination of petrophysical, physical and geometrical parameters by means of geophysical methods for water-exploration. Surveying and detailed geophysical research methods. Studying geophysical forward modeling and inverse problems related to water exploration possibilities and demands. Profiling, mapping, tomographical geophysical methods. Well-logging (borehole geophysical) methods and interpretation procedures. Complex exploration work and interpretation. Documentation for water-exploration.
Practical work: self-made solutions of simple case-study problems.
Compatencies to evolve:
Knowledge: T4, T5
Ability: K1, K3, K5, K8, K9, K10, K12
Attitude: A1, A5, A6, A7, A8, A9
Autonomy and responsibility: F1, F2, F3, F4, F5, F6

Assessment and grading:
Condition for obtaining the signature: the presence in at least 60 % of the lessons.
The determination of the examination grade is entirely based on the result of examination.
Grading scale (% value → grade): 0 – 49 % → 1 (fail), 50 – 64 % → 2 (pass),
65 – 79 % → 3 (satisfactory), 80 – 89 % → 4 (good), 90 – 100 % → 5 (excellent).

Compulsory or recommended literature resources:

- Edited by P. Vass: course slides converted in pdf format: http://geofizika.uni-miskolc.hu/education.html
- Szabó N. P., 2014. Geophysics of exploration for water. Electronic handout, p. 233.
- Edited by R. Kirsch, H Rumpel, W Scheer, H Wiederhold 2006: Groundwater Resources in buried Valleys – a Challenge for Geociences, Leibnitz Institute for Applied Geosciences, Hannover, Germany, ISBN-10: 3-00-020194-7
- Edited by Reinhard Kirsch, 2009 : Groundwater Geophysics - A Tool for Hydrogeology, Springer-Verlag Berlin Heidelberg, ISBN: 978-3-540-88404-0
- Edited by Yoram Rubin , Susan S. Hubbard, 2005 : Hydrogeophysics, Springer Dordrecht, Berlin, Heidelberg, New York, ISBN-10 1-4020-3101-7 (HB)
- Prem V. Sharma, 1997 : Environmental and engineering geophysics, Cambridge University Press, ISBN-10: 0521576326
- Asquith, G. B, Krygowski, D., Henderson, S., & Hurley, N., 2004: Basic well log analysis,. 2nd edition, American Association of Petroleum Geologists.

Course Title: Geotechnical engineering **Instructor:** Dr. Tamás Madarász, associate professor	**Code:**MFKHT720025 **Responsible department/institute:** Deparment of Hydrogeology and Engineering Geology Type of course: Compulsory
Position in curriculum (which semester): 2	**Pre-requisites (if any):** MFKHT710008
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 students will be familiar with the basic concepts of geotechnical engineering, with the principles of designing and with the construction methods of different buildings and objects.

The short curriculum of the subject:

Review of foundation studies. Legal and authorization background. EUROCODE 7. Concrete as building material. Engineering design, stresses and loads. Design of concrete and reinforced concrete structures. Design of retaining walls. Jet-grouting. Building of slurry wall. Digging/excavations. Building of water-supply and channeling networks. Underground structures. Utility ducts. Hydraulic engineering structures: river walls, dams, controlling objects.

Practical work: self-made solutions of simple case-study problems

Compatencies to evolve:

Knowledge: T3, T6, T7, T8

Ability: K2, K4, K7, K8, K10, K12, K13, K14, K15

Attitude: A1, A2, A3, A4, A5, A6, A7, A8, A9

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

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:

- Aysen A.: Soil mechanics, Basic concepts and engineering applications, Taylor&Francis, 2002.
- Jonathan Knappett, R.F. Craig: Craig's Soil Mechanics, Eighth Edition, 2012.
- Charles W. W. Ng., Menzies B.: Advanced unsaturated soil mechanics and engineering, Spon Press, 2007.
- Jiang M., Liu F., Bolton M.: Geomechanics and geotechnics: from micro to macro, Taylor and Francis 2010.
- Orr T. L. L., Farell E. R.: Geotechnical design to EUROCODE 7, Springer-Verlag, London 1999.
- I. Vanícek, M. Vanícek: Earth Structures. Springer, ISBN: 978-1-4020-3963-8, 2008. pp. 497-606

Course Title: Water chemistry **Instructor:** Dr. János Lakatos, associate professor	**Code:** AKKEM6005 **Responsible department/institute:** Department of Chemistry 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):** practice mark
Credits: 2	**Course:** full time

Course Description:
The studentswill be familiarwiththestructure and chemicalproperties and reactivity of watermolecule, and willlearnaboutthe main principle of theequilibriumsexistinaquaticsystem.

The short curriculum of the subject:
Physical and chemical properties of water. The state diagram of water. Properties of ice, liquidwater and steam. Supercritical state of water. The chemical structure of water molecule and its consequences. Behaviour of water as a solvent. Dissolution process of gases, liquids and solids in water. Behaviour of water as a chemical partner. Acid base equilibria, hydrolysis, complex formation and redox reactions. Isotopic, and chemical compositions of different waters. The main characteristic parameters used for description of water quality.

Compatencies to evolve:
Knowledge: T1, T2, T6, T7, T8
Ability: K1, K6, K9, K10, K11, K12, K15
Attitude: A2, A5
Autonomy and responsibility:F2, F5, F6

Assessment and grading:
Studentswill be assessedwithusingthefollowingelements.

Attendance:	15 %
Shortquizzes	10 %
Midtermexam	40 %
Finalexam	35 %
Total	100%

Gradingscale:

% 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:

- Orbán Vera: Vízkémia, PMMF, Baja, 1980.
- Orbán Vera: Vízkémiai parktikum, Egyetemi jegyzet, Tankönyvkiadó, 1976.
- Papp Sándor, Rolf Kümmel: Környezeti Kémia, Tankönyvkiadó, Budapest, 1992.
- Kirnerné Kiss Andrea: A víz kémiája, Kémia Műszakiaknak, 3. 1 fejezet. Szerk. Berecz E. Tankönyvkiadó, Budapest, 1991.
- Stanley E. Manahan: EnvironmentalChemistry, 7.thed. Lewis Publishers, 2000.
- F. M. M. Morel: Principles of aquatic Cemistry.
- J. Lakatos . Geothermal Hydrochemistry (2014),
- https://www.tankonyvtar.hu/hu/tartalom/tamop412A/2011_0059_SCORM_MFAKK5061-EN/sco_00_01.htm
- P.L Breonik, W.A Arnold: Water Chemistry, An introduction to the Chemistry of natural and Engineered aquatic system. Oxford (2011)
- https://global.oup.com/academic/product/water-chemistry-9780199730728?cc=hu&lang=en&
- C. Baird Environmental Chemistry , Freeman and Company, New York (1995)

- W. Stumm: Aquatic Chemistry , An introduction emphasizing chemical equilibria in natural waters, John Wiely and Sons, New York, (2012).

Course Title: Regional hydrogeology **Instructor:** Dr. Enikő Darabos, assistant lecturer	**Code:**MFKHT720026 **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+0	**Type of Assessment (examination/ practical mark / other):** exam
Credits:2	**Course:** full time

Course Description:

To familiarize students with the hydrogeological structure of Hungary. A detailed overview of being a hydrological basin country. To prepare student how to solve basic hydrology-based design problems.
The short curriculum of the subject:
Water supplies of Hungary, major outlines of water supply management. Regional tectonics parts of Hungary. The hydrological division of Hungary and the basis of division; their comparisons. Water bodies. Utilization and its possibilities, quantity and areas of different water types (shallow ground water, bank-filtered water, deep ground water, water of fissure rocks, karst water. Thermal water reserves in porous and karstic rocks. Mineral and medicinal waters. Matters of regional water production. Water supply protection.
Compatencies to evolve:
Knowledge: T1, T2, T6, T7
Ability: K8, K10
Attitude: A4
Autonomy and responsibility:F3, F5, F6

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)

- C.W., Fetter Jr.: Applied hydrogeology; Mitsch, W. J., Gosselink, J. G.: Wetlands
- J. M. Sharp: Fractured Rock Hydrogeology; B. B. S. Singhal – R. P. Gupta: Applied Hydrogeology of Fractured Rocks; S. Eslamian: Handbook of Engineering Hydrology - Fundamentals and Applications
- Freeze, R. A., Cherry, J. A.: Groundwater, Prentice Hall, 1979;
- Fetter Jr., C. W.: Applied Hydrogeology (4th Edition), Pearson, 2014;
- Kreitler, C. W.: Hydrogeology of sedimentary basins. Journal of Hydrology, 1989, 106, 29-53;
- Hubbert, M. K.: The Theory of Ground-water Motion. The Journal of Geology, 1940, 48, 785-944;
- Tóth, J.: A Theory of Groundwater Motion in Small Drainage Basins in Central Alberta, Canada. Journal of Geophysical Research, 1962, 67, 4375-4387;
- Tóth, J.: A theoretical analysis of groundwater flow in small drainage basins. Journal of Geophysical Research, 1963, 68, 4795-4812)
- M. Karamouz – A. Moridi – S. Nazif: Urban Water engineering and management, CRC Press; E. Vázquez-Sune – X. Sanchez-Vila – J. Carrera: Introductory review of specific factors influencing

urban groundwater, an emerging branch of hydrogeology, with reference to Barcelona, Spain, Hydrogeology Journal, 2005 13, pp. 522-533)

Course Title: Waterworks, water supply **Instructor:** Dr. Tamás Madarász PhD, associate professor Gábor Nyiri, PhD student	**Code:** MFKHT720027 **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): 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 elements of modern waterworks and water supply. Based on a sample network design, the students will be able to design the necessary parts of a working waterworks plant as well as pipe system of the water distribution system.

The short curriculum of the subject:

The estimation and calculation of the water demand. Water demand for the fireflow. The measurement of the water loss in the supply system. Requirements concerning the water quality. Pumps, pipes, water towers and their hydraulics. The principal assignments of this subject are the design and management calculations of a water distribution network. The class shall be guided through the protocol of designing a simple water distribution network. Minor separate assignments may be given to the class. The individual project progress shall be discussed on during the class meetings. The principle assignment submission deadline is the last course meeting. Written submissions (drawings, reports, etc) are to emphasize clarity and legibility. Competencies to evolve:

Knowledge: T1, T2, T4, T5, T8

Ability: K1, K4, K5, K6, K8, K10, K11, K13, K14, K15

Attitude: A1, A2, A3, A4, A5, A6, A7, A8, A9

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

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	10 %
Assignment reports	50 %
Final exam	40 %
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:

- HAESTAD Methods Advanced water distribution modeling and management http://systemssolution.net/cadtechno/0%20SAMPLE/SPECs%20&%20DETAILS/BOOKS%20MECHANICAL/PLUMBING/WATER%20DISTRIBUTION%20MODELING.pdf
- Avi Ostfeld: Water Supply System Analysis, ISBN 978-953-51-0889-4, InTech, 2012.
- Beckwith S., Chase D. V., Garyman W., Koelle E.,Savic D., Walski T. M.: Advanced water distribution modeling and management, Bentley Institute Press, 2007.
- R. M. Clark, S. Hakim, A. Ostfeld: Handbook of Water and Wastewater Systems Protection, e-ISBN 978-1-4614-0189-6, Springer, 2011.
- D. D. Ratnayaka, M. J. Brandt, K. M. Johnson: Twort's Water Supply, ISBN: 978-0-7506-6843-9 Elsevier, 2009
- Swamee P. K., Sharma A. K.: Design of water supply pipe networks, Wiley-Interscience, 2008.

Course Title: Groundwater flow and contaminant transport modeling **Instructor:** Dr. Balázs Kovács, honorary associate professor	**Code:** MFKHT720028 **Responsible department/institute:** Institute of Environmental Management Type of course: Compulsory
Position in curriculum (which semester): 2	**Pre-requisites (if any):** MFKHT710017
No. of contact hours per week (lecture + seminar): 2+2	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 5	**Course:** full time

Course Description:

The students will be familiar with the theoretical and practical aspects of the numerical methods widely used in the modern hydrogeology. The students will be able to use a worldwide known numerical environment. Using this environment the students will possess an ability to solve simple problems in the field of hydrodynamics and contaminant transport, and will learn that basic knowledge based on which getting more experiences they will be later able to solve also more complex simulation problems.

The short curriculum of the subject:

Tasks and aims of GW flow and contaminant transport modeling. Theory of GW flow modeling: the flow equation and its numerical solutions. The phenomena of contaminant transport in porous medium, the different forms of the transport equation. Analytic and numerical solutions. Particle tracking algorithms. Data-system of GW flow and contaminant transport models. The reliability of data, the aspects of data evaluation and control, type of dataset errors. Calibration of models. GW flow and contaminant transport modeling using the Processing MODFLOW environment. Solution of demo problems and investigation of case studies. Practical work: self-made models of simple real problems.

Compatencies to evolve:

Knowledge: T1, T2, T4, T5, T7

Ability: K1, K2, K3, K4, K5, K6, K7, K8, K13, K15

Attitude: A8

Autonomy and responsibility:F1, F5, F6

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:

- Chiang, W-H. – Kinzelbach, W.(2001): 3D-Groundwater Modeling with PMWIN, A Simulation System for Modeling Groundwater Flow and Pollution, Springer-Verlag Berlin, Heidelberg, New York, ISBN 3-540-67744-5, SPIN 10774334
- Kinzelbach, W. (1986): Groundwater Modelling (An Introduction with Sample Programs in BASIC), Elsevier, p.331.
- Kovács B.: Hidrodinamikai és transzportmodellezés Processing MODFLOW környezetben I., 2004, Miskolci Egyetem – Szegedi Tudományegyetem – GÁMA-GEO, p. 160., ISBN 963 661 637 X
- Kovács – Szanyi: Hidrodinamikai és transzportmodellezés II., 2005, Miskolci Egyetem – Szegedi Tudományegyetem – GÁMA-GEO, p. 213., ISBN 963 661 638 8

- Neven Kresic (1997): Quantitative Solutions in Hydrogeology and Groundwater Modeling. Lewis Publishers
- Andersen P. F., 1993. A manual of instructional problems for the U.S.G.S. MODFLOW model. Center for Subsurface Modeling Support. EPA/600/R-93/010.
- Anderson, M. P. and W. W. Woessner, 1991. Applied groundwater modeling: simulation of flow and advective transport. 381 pp. Academic Press, San Diego, CA
- Bear, J., 1972. Dynamics of fluids in porous media. American Elsevier Pub. Co., New York
- Bear, J., 1979. Hydraulics of Groundwater, McGraw-Hill, N.Y., 569 p
- Bear, J. and A, Verruijt, 1987. Modeling groundwater flow and pollution, D. Reidel Publishing, Dordrecht, Holland
- Fetter, C.W. 1994. Applied Hydrogeology, 3rd Edition. Macmillan College, New York, 691 p
- Freeze, R. A. and J. A. Cherry. 1979. Groundwater. Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

Course Title: Quality Management **Instructor:** Dr. László Berényi, associate professor	**Code:** GTVVE7002MA **Responsible department/institute:** Institute of Management Science Type of course:Compulsory
Position in curriculum (which semester): 3	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 2	**Course:** full time

Course Description:

The objective of the course is to prepare students to perform professional tasks on a higher level by applying the approach of quality management, including managing or participating related projects. The student will learn about principles, concept and terminology of quality management, quality-related corporate activities, requirements of the ISO 9001 standard and the specialities of project quality management.

Lectures:

1. week: Terminology of quality management (principles, 5 approaches, 9 influencing factors), history of quality management.
2. week: Quality management standardization. ISO 9000 family. Concept of quality management by ISO 9001.
3. week: Process approach in quality management. Kaizen.
4. week: ISO 9001 requirement: Management system.
5. week: ISO 9001 requirement: Product and production.
6. week: Auditing quality management system. ISO 19011:2011 standard.
7. week: Total Quality Management. Lean approach in quality management.
8. week: Enhancing quality management, integrated management systems.
9. week: Quality tools: 7 old&new tools, finding the root cause, 8D
10. week: Quality tools: FMEA, QFD
11. week: Business excellence. Quality Awards. Tools and methods of self-evaluation.
12. week: Project quality management: planning.
13. week: Project quality management: risk analysis.
14. week: Project quality management: monitoring and performance evaluation.

Compatencies to evolve:
Knowledge: T7
Ability: K2, K10, K12,
Attitude: A4, A7
Autonomy and responsibility: F3, F4

Assessment and grading:

40%: successful midterm test; 20%: presentation about a chosen quality management tool; 40%: oral 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:

Compulsory literature

- Berényi L: Fundamentals of Quality Management. LAP, Saarbrücken, 2013.
- Vivek, N.: Quality management system handbook for product development companies, CRC Press, Boca Raton, 2005.
- Foster, S.T.: Managing Quality Integrating the Supply Chain, Pearson, London, 2011

Recommended literature

- P. J. Lederer, U. S. Karmarka: The Practice of Quality Management, Springer, 1997.
- Kanji, G.K., Asher, M.: 100 Methods for Total Quality Management, SAGE , London, 1996
- Griffith G.: Quality Technician's Handbook, Pearson, London, 2003.

Course Title: Legal and economic studies with regard to mining and geology	**Code:** MFFTT730027 **Responsible department/institute:** Institute of Mineralogy and Geology
Instructor: Dr. Mádai Ferenc, associate professor	Type of course: Compulsory
Position in curriculum (which semester): 3	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 2	**Course:** full time

Course Description:

The main objective is to provide an in-depth and practical knowledge of the supranational and national legislation and regulatory framework with regard to mining and geology.

The short curriculum of the subject:

1. Essential legal terms and definitions
2. Specific Community legislation of the European Union (the „acquis")
3. International conventions and standards
4. The Hungarian national mining and geology legislation
5. Other Hungarian acts on the environment, energy, water, etc.
6. Other national quasi-legislation (orders of MBFH) and the licensing framework

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1. The concept of sustainable development, its role for the mineral ectractive industry, marginal cost defining factors, concept of mineral rent,
2. The Hotelling rule and its resolution under certain conditions,
3. Financial analysis of mining projects, cost types, deposit parameters (flow, fund, bonity, quality),
4. Discounted cash flow methods in the mineral industry, mineral taxation.

Compatencies to evolve:

Knowledge: T6, T7

Ability: K10, K11, K12, K15

Attitude: A4, A5, A8

Autonomy and responsibility:F2, F4, F5

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:

- Wagner H. et al. 2006: Minerals planning policies and supply practices in Europe – European Commission Directorate, General Enterprise, University of Leoben
- Hámor T. 2004: Sustainable mining in the European Union: The legislative aspect – Environmental Management, Vol. 33., pp. 252-261.
- Pearce, D.W. & Turner R.K. Economics of natural resources and the environment (Harvester Wheatsheaf, London, 1990)
- The minerals and metals policy of the Government of Canada: Partnerships for the sustainable development Ministry of Public Works and Government Services Canada, 1996
- Whateley, M.K.G. & Harvey, P.K. (eds.) Mineral resource evaluation II: Methods and case stories (Geological Society Spec. Publ. No. 79., London, 1994)

- J. Otto & J. Cordes. The Regulation of Mineral Enterprises: A Global Perspective on Economics, Law and Policy; (RMMLF, 2002.)

Course Title: Geothermics **Instructor:** Dr. Anikó Tóth, associate professor	**Code:** MFKGT730021 **Responsible department/institute: Natural Gas** Engineering Department
	Type of course: Compulsory
Position in curriculum (which semester): 3	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 2	**Course:** full time

Course Description:

Students study the production and utilization technologies of geothermal energy, based on the applied fluid mechanics and heat transfer. They can get the ability to elaborate geothermal projects, feasibility studies. They will became to organize and lead implementations of different geothermal energy production and utilization systems.

The short curriculum of the subject:

Origin and nature of geothermal energy. Geothermal systems (2 lectures). Main types of geothermal reservoirs. Fluid mechanics and heat transfer in production and injection wells, and bore-hole heat exchangers (2 lectures). Subsurface and surface production equipments: submersible pumps, heat exchangers, heat pumps, HDR, EGS technologies. Rankine, ORC and Kaline cycles (2 lectures). Electricity production and direct uses. Lindal diagram. Environmental impacts.

Compatencies to evolve:

Knowledge: T4, T5, T7

Ability: K1, K2, K5, K6, K13

Attitude: A2, A9

Autonomy and responsibility:F2, F5

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:

- Elder J. W., Rybach L., Stegena L.: Geothermics and geothermal energy, Birkhauser Basel,1979
- Lund J.: Geothermal Power Plants, Geo Heat Center, Oregon, USA, 2004.
- Lund J.: Direct Heat Utilization of Geothermal Energy, Geo Heat Center, Oregon, USA, 2002.
- Rybach L.-Muffler L.J.R.: Geothermal Systems, John Willey New York, Brisbane, Toronto, 1981.
- Toth A.-Bobok E.: Limits of sustainable heat extraction from dry holes. Stanford University, 2008.

Course Title: Watermining **Instructor:** Dr. László Lénárt, associate professor	**Code:** MFKHT740021 **Responsible department/institute:** Institute of Environmental Management Type of course: Compulsory
Position in curriculum (which semester): 3	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 3	**Course:** full time

Course Description:

The students shall be acquainted with the design, drilling, construction and operation of groundwater wells. The curriculum discusses other type of water production installations. The students will be competent in designing a drilled groundwater well and preparing the documentation for the technical and legal permission of the well. Production techniques, operation and maintenance of groundwater wells close the curriculum.

The short curriculum of the subject:

Selection of drilling technique and its main aspects, influencing factors in drilling operations, Classification of groundwater wells, applied well designs, types and classification of well screens, design and requirements of well screens, materials of well screens, screen installation techniques, installation of groundwater well, measurements in operating wells, well maintenance and repair, Well design project.

Practical work: self-made solutions of simple case-study problems.

Compatencies to evolve:

Knowledge: T1, T2, T4, T7, T8

Ability: K1, K4, K5, K7, K8, K9, K10, K12, K14

Attitude: A7, A9

Autonomy and responsibility: F2, F5

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:

- Achmed N., Taylor S. W., Sheng Z.: Hydraulics of wells: design, construction, testing, and maintenance of water well systems, American Socity of Civil Engineers, 2014
- Aler L.: Handbook of suggested practices for the design and istallation of ground-water monitoring wells, National water well association, 1989.
- Bloetscher F., Munitz A., Largey J.:Siting, drilling and contruction of water supply wells, American Water Works Association, 2007.
- State coordinating committe on Ground water: State of Ohio Technical Guidance for Well Construction and Groundwater Protection, USA 2000
- F. G. Driscoll: Groundwater and Wells I. II. III., Johnson Division, St. Paul Mn, 1990, USA

Course Title: Hydrogeological interpretation **Instructor:** Dr. Tamás Madarász, associate professor	**Code:** MFKHT730024 **Responsible department/institute:** Institute of Environmental Management Type of course: Compulsory
Position in curriculum (which semester): 3	**Pre-requisites (if any):** MFKHT710017
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 2	**Course:** full time

Course Description:

The students will be familiar with the basic concepts, tasks and purposes of complex hydrogeological interpretation. The students will also learn about the main properties of measured hydrological and hydrogeological data sets and about geostatistical as well as optimization calculations. The students will be prepared to process and analyze multidimensional hydrogeological data sets on order to make effective interpretation.

The short curriculum of the subject:

Measurements and data set types in hydrogeology and hydrology. Data processing to gain information. Data distribution models in groundwater science. Fitting and regression analysis. The role of histograms. Sample statistical properties, uncertainty determination. Frequently used statistical probes in water sciences. The basic concepts of optimization. Rare event determination concerning flood levels and groundwater levels. Water level curve characteristics. Sample collection strategy in environmental and water sciences. Determination of weather probability curve. Extreme precipitation events and their predictions. Complex interpretation of different types of groundwater data.

Compatencies to evolve:

Knowledge: T1, T2, T4, T5, T7, T8

Ability: K2, K4, K5, K6, K9, K10, K13, K14

Attitude: A1, A4, A6, A8

Autonomy and responsibility:F1, F2, F5, F6

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:

- Dr. Steiner Ferenc: A geostatisztika alapjai. Tankönyvkiadó, Budapest, 1990.
- Dr. Csoma János, Dr. Szigyártó Zoltán: A matematikai statisztika alkalmazása a hidrológiában. VITUKI, Budapest, 1975.
- EPA QA/G-9: Guidance for Data Quality Assessment. Practical Methods for Data Analysis. 2000.
- D.R. Helsel, R. M. Hirsch: Statistical Methods in Water Resources. Elsevier, 1992. Graham Borradaile: Statistics of Earth Science Data. Springer, 2003.
- Webster R., Oliver A. M.: Geostatistics for environmental scientist, Wiley, 2007.

Course Title: Drilling, Deep Drilling **Instructor:** Dr. Imre Federer, associate professor	**Code:** MFKOT730029 **Responsible department/institute:** Petroleum Engineering Department Type of course: Compulsory
Position in curriculum (which semester): 3	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 2	**Course:** full time

Course Description:

The subject introduces the basic properties of hydrocarbon and geothermal well drilling technology and the knowledge for design and operate of drilling methods. The students will be familiar with the basic concepts of modern drilling technology as well as field engineering. The students will learn about the relationships of pressure balance in the drilled hole, about the phenomena of well planning. The students will be able to handle and solve basic problems in shallow and deep well drilling. The main relationships of mud logging, cutting transport and well testing concerning the well structure determination and well hydraulics problems are also discussed. The students will be able to measure and calculate the mud properties, the casing shoe setting depth. The students will be able to carry out the formation integrity test, and they will be able to interpret the obtained results effectively.

The short curriculum of the subject:

Drilling rig types and components. Usable drill string selection. Drill bit classification. Coring tools and procedures. Drilling fluid selection. Drilling control and mud logging. Causes of abnormal pressure. Facture gradient determination. Casing seat selection. Using of kick tolerance calculation to calculate internal well bore pressure. Casing steel properties. Casing design principles. Primary cementing design and operation. Well geometry of directional and horizontal wells. Survey tools selection. Well bore stability. Identification of hole problems. Free point determination and back-off operation. Primary and secondary well control. Drill stem test tools and procedures. Cased hole completion.

Compatencies to evolve:

Knowledge: T3, T7, T8

Ability: K4, K5, K6, K7, K8, K9, K12, K14

Attitude: A1, A3, A5

Autonomy and responsibility: F1, F2, F3, F6

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:

- H.Rabia: Oilwell Drilling Engineering. Principles and Practice. Graham Tratman Ltd. London 1995. 322 p.
- Howard B. Bradley: Petroleum Engineering Handbook, Third Printing, Society of Petroleum Engineers, Richardson, TX, U.S.A. 1992.

- Ron Baker: Practical Well Control, 4 th Edition, 1999, Complies with IADC WellCAP Accreditacion Standards. Drilling Data Handbook, Edítion Technip, Paris 1999. 542 p.
- Dr. Szepesi J.: Mélyfúrás. A tároló formációk serkentő kezelésének alapjai. Tankönyvkiadó, Bp. 1985. 344 p. Árpási M.: Mélyfúrás. Mélyfúrási csövek és méretezése. Tankönyvkiadó, Bp. 1991. 483 p.
- Somlyódy, L. [Editor] (2002): A hazai vízgazdálkodás stratégiai kérdései. (Strategic Issues of the Hungarian Water Resources Management) MTA, Budapest, 2002.
- Water Framework Directive (WFD 2000) 2000/60/EC of the European Parliament and of the Council of 23 Oct. 2000 establishing a framework for Community action in the field of water policy. Bruxelles.

Course Title: Water and waste water treatment **Instructor:** Dr. Sándor Nagy, associate professor	**Code:** MFEET730028 **Responsible department/institute:** Institute of Raw Material Preparation and Environmental Processing
	Type of course: Compulsory
Position in curriculum (which semester): 3	**Pre-requisites (if any):** MFKHT720003
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 2	**Course:** full time

Course Description:

Acquired store of learning:

The students will be familiar with the basic elements and concepts of modern water and waste water purification technology and processes. The students will be able to choose the right purification technology concerning environmental protection aspects.

The short curriculum of the subject:

Contamination and pollution processes in water. Pollution limits in water and in groundwater. The most typical contaminants and their physical and chemical properties. Sampling, and preparations of samples. Treatment processes: mechanical processes I. Treatment processes: mechanical processes II. Treatment processes: chemical processes. Treatment processes: biological processes. Cleaning and purification technology for municipal waste water I. Cleaning and purification technology for municipal waste water II. Cleaning and purification technology for industrial waste water. Case study. Technology design.

Compatencies to evolve:

Knowledge: T2, T7, T8

Ability: K3, K6, K9, K10, K11, K15

Attitude: A3, A7, A8

Autonomy and responsibility: F1, F2, F3, F6

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:

- Klaus Görner- Kurt Hübner: Gewaesserschutz und Abwasserbehandlung; Springer-Verlag Berlin heidelberg, 2002.
- M Henze; P Harremoes; J la C Jansen; E Arvin: Wastewater Treatment; Springer-Verlag Berlin heidelberg, 2002
- Hungarian and English textbooks, and Internet resources
- Spellmann F. R.:Handbook of water, and wastewater treatment plant operations, Lewis Publishers, 2003.
- Woodard F.: Handbook of water, and waste water treatment technologies, Butterworth-Heinemann, 2001.

- Dr. Michael R. Templeton , Prof. David Butler: Introduction to Wastewater Treatment. 2013
- Drechsel, Pay, Qadir, Manzoor, Wichelns, Dennis (Eds.): Wastewater Economic Asset in an Urbanizing World. Springer 2017.
- Fatta-Kassinos, Despo, Dionysiou, Dionysios D., Kümmerer, Klaus (Eds.): Advanced Treatment Technologies for Urban Wastewater Reuse

Course Title: Environmental Risk Assessment and Remediation **Instructor:** Dr. Tamás Madarász, associate professor	**Code:** MFKHT730026 **Responsible department/institute:** Institute of Environmental Management Type of course: Compulsory
Position in curriculum (which semester): 3	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 3	**Course:** full time

Course Description:

The students will be familiarized with the basic concept and framework of Environmental and Human Health Risk assessment and its relationship to contaminated land remediation. The students shall be competent in reading and understanding risk assessment documentation and evaluating its correctness. They will be able to work together with other field specialists in a risk assessor team. They will get a brief introduction to remediation practices and their design and the European practice of remediation planning and monitoring.

The short curriculum of the subject:

History of Risk Assessment, principles and background of RA methodology, Overview of risk related terminology and definitions, Elements of HHRA methodology, Problem formulation, Exposure assessment, Toxicity assessment, Risk Characterization, Risk assessment and its role in site remediation, Risk interpretation, EU legislation and practice of RA methods, legal background, various applications of RA methods, risk based target value and its determination, Case studies.

Practical work: Hands-on activity of simple case-study problems

Compatencies to evolve:

Knowledge: T3, T4, T7, T8

Ability: K1, K2, K3, K6, K7, K10, K13, K15

Attitude: A2, A3, A7

Autonomy and responsibility:F1, F4, F5, F6

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:

- CARACAS (1998): Risk Assessment for Contaminated Sites in Europe, Volume 1: Scientific Basis; LQM Press, Nottingham, UK
- USEPA, (1986): Guidelines for Carcinogen Risk Assessment. 51 Federal Register 33992.
- Vegter, J.J. (2001): A Risk-Based Land Management Approach; Land Contamination and Reclamation, Vol. 9, No. 1, Richmond, UK
- Twardowska I., Allen H. E., Haggblom M. M, Stefaniak S.: Valiable methods of soil and water pollution monitoring, protection and remediation, Springer, 2006.
- Health Canada (1993): Human Health Risk Assessment of Chemicals from Contaminated Sites, Volume 1 and 2.: Risk Assessment Guidance Manual; Ottawa, ON.

- Covello, V. – Mumpower, J. (1985): Risk Analysis and Management: A Historical Perspective, Risk Analysis, Vol. 5, No. 2
- CLARINET and NICOLE (2001): The Sustainable Management and Remediation of Contaminated Land, Special Edition of Land Contamination and Reclamation, Editors: Bardos, P. and Lewis, A., Richmond, UK.

Course Title: Environmental Geotechnics **Instructor:** Dr. Andrea Tóth Kolencsikné, assistant lecturer	**Code:** MFKHT730030 **Responsible department/institute:** Institute of Environmental Management Type of course: Compulsory
Position in curriculum (which semester): 3	**Pre-requisites (if any):** MFKHT710008
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 2	**Course:** full time

Course Description:

The students will be familiar with the basic concepts of environmental geotechnics.

The short curriculum of the subject:

Physiochemistry of soils for geoenvironmental engineering. Changing of soil parameters caused by contaminants. Determination of contaminant retention capacity of soils. Barrier systems, geological and geosynthetic barrier systems, horizontal and vertical barriers. Geotechnical aspects of landfilling. Stability and deformation of waste dumps, liner systems. Geotechnical tasks of recultivation. Investigation of contaminated sites. Geotechnical problems of remediation. Waste as constructions material. Soil improvement.

Compatencies to evolve:

Knowledge: T3, T7, T8

Ability: K7, K10, K13, K14, K15

Attitude: A2, A5, A7

Autonomy and responsibility: F1, F3, F6

Assessment and grading:

Students have to prepare a project work during the semester, and several calculation tasks and lab experiments.

Students will be assessed with using the following elements:

Attendance:	15 %
Short quizzes	10 %
Project work	40 %
Calculation and lab tasks	35 %
Total	100%

Requirement for the signature: >60%

Grading scale of the final exam:

% 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:

- Kézdi Á.: Talajmechanika I-II. Műszaki Knyvkiadó, 1969.
- Szabó I.: Hulladékelhelyzés Egyetemi tankönyv, Miskolci Egyetemi Kiadó, 1999.
- Filep Gy.–Kovács B.–Lakatos I.–Madarász T.–Szabó I. (szerk. Szabó): Szennyezett területek kármentesítése. Miskolci Egyetemi Kiadó, 2002.
- Sarsby, R.: Environmental Geotechnics. Thomas Telford, 2000.
- Davis, M.L.- Cornwell, D.A.: Introduction to Environmental Engineering. WCB McGraw-Hill, Boston, 1998.
- Bell, F.B.: Environmental Geology. Blackwell Science Ltd, Oxford, 1998.
- Rowe, K.R.: Geotechnical and Geoenvironmental Engineering Handbook. Kluwer Academic Publishers, 2000.

Course title: Surfer for windows hands on training **Instructor:** Dr. Mikita Viktória, assistant professor	**Code: MFKHT73005** **Responsible department/institute:** Hidrogeológiai-Mérnökgeológiai Intézeti Tanszék/ Környezetgazdálkodási Intézet **Type of course:** optional
Position in curriculum (which semester): 6	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination/ practical mark / other**): exam
Credits: 3	**Course:** full time

Course description

The students will be able to use the most common practical applications of the Surfer for Windows software. They will able to solve some engineering tasks related to area and volume integral problems they can edit various maps and perform data processing tasks.

The short curriculum of the object:

- The theoretical background of grid files,
- Introduction to interpolation algorythms
- Math with grid files (on 2 occasions),
- Volume calculations
- 2D mapping techniques: base maps, contour maps, post maps, vector maps (on 2 occasions)
- 2.5 D spatial mapping techniques: 3D wireframe, surface and watershed maps (on 2 occasions)
- Data transfer to Processing MODFLOW

Competencies to evolve:

Knowledge: T4, T5, T6, T7, T10, T12
Ability: K1, K2, K3, K4, K5, K13
Attitude: A1, A2
Autonomy and responsibility: F1, F3

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 and recommended literature resources:

Surfer 12 Users Guide, Golden Software Inc., 2014. Denver.
Hamilton, D.E.-Jones, T.A.: Computer modeling of geological surfaces and volumes. - AAPG Computer applications in geology. No.1. p589. Tulsa, Oklahoma
Chiang, W-H. – Kinzelbach, W.(2001): 3D-Groundwater Modeling with PMWIN, A Simulation System for Modeling Groundwater Flow and Pollution, Springer-Verlag Berlin, Heidelberg, New York, ISBN 3-540-67744-5, SPIN 10774334
Kinzelbach, W. (1986): Groundwater Modelling (An Introduction with Sample Programs in BASIC), Elsevier, p.331.
Anderson, M. P. and W. W. Woessner, 1991. Applied groundwater modeling: simulation of flow and advective transport. 381 pp. Academic Press, San Diego, CA

Course Title: Wellfield and groundwater resources protection (Optional subject group (2)) **Instructor:** Dr. László Perger, invited lecturer	**Code:** MFKHT730032 **Responsible department/institute:** Institute of Environmental Management Type of course: Optional
Position in curriculum (which semester): 3	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 1+2	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 3	**Course:** full time

Course Description:

For the beginning students get information on features and hydrological-hydrogeological background of the hungarian drinking water supplying and legistlation rules of groundwater management. Next, this topic shall present how should this groundwater management be connected with EU legistlation, namely with 2000/60 EU Framework Directive and 2006/118 EU Groundwater Directive. In addition how should we harmonise the national rules to EU requirements. Main goal to give adequate explanation on the definition of aquifer vulnerability, how to make different management ways in vulnerable porous, karstic and bank filtred media. This topic should provide a methodology for contamination transport modelling reckon with travelling time of the different contamination matters, to make case studies about testing of theoretical/potantial contamination spreadings. Finally, to give information on remediation of contaminated zones, and programme of measures.

The short curriculum of the subject:

Presentation of 2000/60 EU Water Framework Directive and 2006/118 EU Groundwater Directive; preliminary and surveilling works of wellfield and groundwater resources protection (previous research outputs, groundwater monitoring information); qualification of vulnerability of different groundwater and shallow-groundwater aquifers; surveilling and classification of point and diffuse contamination sources, land uses, different ways of prevention; get fit the transport model; to define the travelling time; rik assessment analysis of remediation and restriction of source uses; well protection, well-field protection, groundwater resources protection; calculation and delineation of vulnerable zones; maintenance and monitoring of vulnerable zones, vulnerable transboundary groundwater issues; practices.

Compatencies to evolve:

Knowledge: T1, T2, T7

Ability: K1, K5, K6, K10, K11, K12

Attitude: A5

Autonomy and responsibility: F3, F5

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:

- H. P. Patra, Shyamal Kumar Adhikari, Subrata Kunar: Groundwater Prospecting and Management. Springer Hydrogeology, 2016.
- Tomasz Nalecz: Groundwater Management in the East of the European Union: Transboundary Strategies for Sustainable Use and Protection of Resources. Springer, 2010

- James A. Tindall, James R. Kunkel, Dean E. Anderson: Unsaturated zone hydrology for scientists and engineers , Prentice Hall, Upper Saddle River, New Jersey 07458, 1999
- Vulnerability and risk mapping for the protection of carbonate (karst) aquifers, Final report (edited by Francois Zwahlen), EU Commission Directorate-General for Research COST Action 620, Office for Official Publications of the European Communities, Luxembourg, 2004
- Contaminated Land and the Water Environment, Report of the National Rivers Authority, NRA London, 1994

Course Title: Remote sensing (Optional subject group (2)) **Instructor:** Dr. Norbert Németh, associate professor	**Code:** MFFTT730032 **Responsible department/institute:** Department of Geology and Mineral Deposits Type of course: Optional
Position in curriculum (which semester): 3	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 1+2	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 3	**Course:** full time

Course Description:

Introduction of the basics, physical basis, applications and uses of the remote sensing. Students gain insight to the interpretation of certain data recordings.

General concepts of the remote sensing. Electromagnetic waves and realms of perception, data collecting systems. Instruments of aerial and space remote sensing (photography, CCD, satellites, radar). Remote sensing methods by photography, spectrometry, radiometry and acoustics. Remote sensing observation of global changes of the Earth in the atmosphere, biosphere, hydrosphere and on the continents. Geological and other interpretation of aerial geophysical recordings, aerial photos, radar and acoustic images, use of multispectral and hyperspectral images. Spectral characteristics of the rocks, valley net analysis and recognizable characteristics of classical geological features (volcanic cones, intrusive bodies, bedded strata and tectonic forms). Spectral characteristics of soil types and vegetation. Recognition of soil and plant damages. Spectral characteristics of hydrological systems (rivers, lakes, seas). Application of the remote sensing in environment protection, recognition and monitoring of pollutions. Prediction of geological hazards and catastrophes (volcanic eruption, earthquake).

Compatencies to evolve:
Knowledge: T7
Ability: K2, K13
Attitude: A1, A7
Autonomy and responsibility: F6

Assessment and grading:

Signature requirements: attendance on the seminars and pass grade on the midterm exam.
Practical mark: presentation on a choosen topic from the application of remote sensing.
Students will be assessed according to the results of the presentation.
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:

- Fundamentals of Remote Sensing. Canada Centre for Remote Sensing tutorial URL: www.nrcan.gc.ca/earth-sciences/geomatics/satellite-imagery-air-photos/satellite-imagery-products/educational-resources/9309
- Adams, John: Remote sensing of landscapes with spectral images: a physical modeling approach. Cambridge University Press, Cambridge, 2006.
- Thomas M. Lillesand – Ralph W. Kiefer 1987: Remote sensing and image interpretation. John Wiley & Sons, New York, 722p.
- John R. Schott 1997: Remote Sensing: The Image Chain Approach. Oxford University Press, 394p.
- Philipson, W.R. (ed.) 1997: Manual of photographic interpretation (2nd ed). American Society for Photogrammetry and Remote Sensing, Bethesda, Maryland, 700p.

Course Title: Safety techniques and labour safety **Instructor:** Dr. Tibor Szabó, associate professor	**Code:** MFKOT740010 **Responsible department/institute:** Petroleum Engineering Department Type of course: Compulsory
Position in curriculum (which semester): 4	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 2	**Course:** full time

Course Description:

Understand of the basic knowledges of safety techniques and labour safety.

Topics Covered & Course Description:

Basics of fire and explosion protection. Fundamentals of combustion theories, burnings of different materials, autoignitions. Fire protection. Safety aspects of pressure vessels and bottles and other equipment, machines and processes: safety devices, safety questions of settlements and operating. Chemicals safety. Personal protective equipment. Legal background and regulations of labour safety. Requirements for healthy and safe working. Objective and personal conditions of working. Special requirements of processes. The most important rights and duties of employees and employers.

Compatencies to evolve:

Knowledge: T6, T7, T8

Ability: K12, K13, K14, K15

Attitude: A3, A5, A8

Autonomy and responsibility: F1, F4

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:

Relevant laws and regulations in force.

- Általános Tűzvédelmi ismeretek, Népszava Könyv Kft, 2008.
- A tűzvédelmi törvény és az OTSZ, Népszava Könyv Kft, 2008.
- Gázpalackok biztonsága, Népszava Könyv Kft, 2001.
- A kémiai biztonság szabályozása, OTH OMMF kiadvány 2005.
- A munkavédelmi törvény magyarázata, KJK KERSZÖV, 2005. ISBN 9632247752
- Érvényben lévő ide vonatkozó jogszabályok és előírások.
- Robert C. Till, J. Walter Coon: Fire Protection. Springer International Publishing, 2009
- Phil Hughes, Ed Ferrett: Introduction to Health and Safety at Work, Fifth Edition. Butterworth-Heinemann, 2011

Course Title: Strategic Management **Instructor:** Dr. Balaton Károly, full professor	**Code:** GTVVE7041MA **Responsible department/institute:** Institute of Management Science
	Type of course: Compulsory
Position in curriculum (which semester): 4	**Pre-requisites (if any):** GTVVE7002MA
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 2	**Course:** full time

Course Description: The aim of the subject is to represent the reasons of creation of corporations – as non-natural legal entities – (The Netherlands, 1820), development of corporate governance, and American, German, French and Japanese basic model sin the minor of Hungarian practice. Through the flow of EU Co. the subject focuses on the buying foreseen tendencies of corporate governances in case of cluster, network and multiple corporational forms.

Structure of lectures:

Basis of corporate forms and changings from 1820. State-theoretical roots of corporate governance. Inducements of originate of corporations and stock corporations, present forms. Double responsibility, theoretical versions of trusteeship (agency – client). Framework of Board of Directors, functions of CEO, COO and responsibility. Anglo-Saxon model, double directorate. "S" form, stock guarantees and threats in case of disperse ownership structures. Features of German and French model, EU-policy, desirable changes. Disharmony of corporate thought, contradiction of globalization and roles of stockholders. Mintzberg's 5+2 model, as objective drives of corporate development. Organizational movements, detours towards networks and multiple corporational forms. Classical holding – concern. Up – to – date concern directing forms. Elements of concerns, coordinational mechanisms. International samples of multiple corporations. Inducements of strategical alliances. Alliances and globalization. Configuration of alliances. Types and features of corporate – networks. "On-demand" operation, virtual networks. Concept and types of cluster. Features of industrial and regional clusters. "R+D" networks and utilizations. Digest of company – building strategies.

Compatencies to evolve:

Knowledge: T6, T7, T8

Ability: K11, K14

Attitude: A2, A4, A5, A8

Autonomy and responsibility:F2, F4, F5, F6

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:

Compulsory reading:

- Szintay, I.: Stratégiai Menedzsment, Bíbor Kiadó, 2003.
- Tari, E.: Stratégiai szövetségek az üzleti világban, KJK, 1998.
- Grant, R. M.: Contemporary Strategy Analysis. 8th Edition. Wiley, 2010.
- McGrath, R.G.: Transient advantage. Harvard Business Review, June 2013. pp.: 64-70. (To be downloaded)

Recommended reading:

- Bühner, R. – Dobák, M. – Tari, E.: Vállalatcsoportok, Aula, 2002.
- Carayannis, E. G. − Popescu, D. − Sipp, C. − Stewart, M.: Technological learning for entrepreneurial development (TL4ED) in the knowledge economy (KE): Case studies and lessons learned, www. eisz.hu
- Barakonyi, K. – Lorang, P.: Stratégiai menedzsment, KJK, 1991.