University of Miskolc
Faculty of Earth Science and Engineering
Hydrogeological engineering masters course
Course description

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Computer science for engineers

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	1.	Practice mark	2	0l+2p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Mészáros Józsefné dr.	associate professor	Department of Applied Mathematics

The main objectives of the course:

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.
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.

Text books:

1. Stoyan G. (szerk.): *MATLAB,* Typotex, 2005.
2. A. Heck: *Bevezetés a Maple használatába,* JGYF Kiadó, Szeged, 1999.

Other references:

1. Molnárka Gy. (szerk.): A Maple V és alkalmazásai, Springer Hungarica Kiadó, 1996.
2. The MATH WORKS Inc., Release 13 Product Family Documentation Set, 2002.

Numerical methods and optimization

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	1.	Practice mark	2	1l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Mészáros Józsefné dr.	associate professor	Department of Applied Mathematics

The main objectives of the course:
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.

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. Multi aided 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-correktor, finite differences.

Text books:

1. Galántai Aurél: Optimalizálási Módszerek, Miskolci Egyetemi Kiadó, 2004.
2. Molnár Éva-Kálovics Ferenc-Mészáros Józsefné: Numerikus Analízis, Miskolci Egyetemi Kiadó, 1997.
3. Nagy Tamás: Operációkutatás, Miskolci Egyetemi Kiadó, 2006.

Other references:

1. Jaroslav Ramík: Soft Computing: Overview and Recent Developments in Fuzzy Optimization, Listopad, 2001.
2. Rapcsák Tamás: Többcélú döntési problémák, (Egyetemi oktatáshoz segédanyag), 2007.
3. R. Fletcher: Practical Methods of Optimization, John Wiley &Sons, 2000.
4. Philip E. Gill, Walter Murray, Margaret H. Wright: Practical Optimization, Academic Press, 1981.
5. Jorge Nocedal, Stephen J. Wright: Numerical Optimization, Springer, 2000.

Environmental Geology

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	1.	exam	4	2l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Éva Hartai	associate professor	Department of Geology and Mineral Resources

The main objectives of the course:
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.

The short curriculum of the course:
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.

References

F. G. Bell: Geological Hazards: their assessment, avoidance and mitigation. E & FN Spon, London, 1999
Horváth Zs.: A felszín alatti víz és a földtani közeg szennyezés elleni védelme. ELTE, L. W. Lundgren: Environmental Geology. Prentice-Hall Inernational, London, 1999.
C. W. Montgomery: Environmental Geology. McGraw-Hill Companies, Boston, New York, San Francisco, 2005

Geodesy, spatial informatics

Brarnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	1.	Exam	4	2l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Gábor Bartha	Full professor	Institute of Geophysics and Geoinformatics

The main objectives of the subject:
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 technics, the remote data-acquiring methods and use them to solve practical problems. They will learn the application fields of geoinformatics and GIS programs. The students will be competent in the application of modern geodetic technology and geoinformatics in their field .

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 technics in Geodesy: photogrammetry, remote-sensing, GPS, inertial measurements, SAR technology. Geo-objects and geo-models. Raster and Vectormodel. Datastoring technics. Database-modelling in geoinformatics. Thematical data and their storage problems. GIS packages. Digitalization, analitical problems, knowledge based systems in GIS environment.

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

References:
Bartha,G.: Geoinformatika alapjai I-II.
Sárközy, F. Térinformatika
Bácsatyai L.: Geodézia I.
Bácsatyai L.: Geodézia II.
Bácsatyai L.: Földmérés és Térképezés
Bácsatyai L.: Magyarországi Vetületek
Quest: Geodesy Tutorial
Varga,J.: GPS Alapismeretek
Varga,J.: Vetületnélküli Rendszerektől az UTM-ig
Vanicek,P.:Geodesy
Burkard,R.K.: Geodesy for the Layman
Szatmári,J.:Digitális Fotogrammetria
Short,N.: The Remote Sensing Tutorial

References are available for the students on CD.

Mineralogy - geochemistry

Branch	Semester	Requirements	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	1	exam	4	2l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Sándor Szakáll	associate professor, department head	Ásvány- és Kőzettani Tanszék

The main objectives of the subject:
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.

The short curriculum of the subject:
Abundance of chemical elements. Meteorites. Geochemical classification of elements. Chemical composition of Earth. Chemical composition of minerals. Genetic charateristics 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.
Practical work: self-made solutions of simple case-study problems.

References
Albared, F. (2005): Geochemistry. An introduction. Cambridge Univ. Press.
Brownlow, A. H. (1996): Geochemistry. Prentice Hall, New Jersey.

Soil mechanics

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologyst engineer MSc	1.	exam	4	2l+1p	English

Tantárgyfelelős és a tantárgy előadója:

Name	Position	Department
Dr. Imre Szabó	professor, departrment head	Deparment of Hydrogeology and Engineering Geology

The main objectives of the subject:
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.

References:

Kézdi Á.: Talajmechanika I-II.
Műszaki könyvkiadó, 1969.

Szabó I.: *Alapozás*
Egyetemi jegyzet, Tankönyvkiadó, Budapest, 1988.

Juhász J.: Mérnökgeológia I-III.
Miskolci Egyetemi Kiadó, 1999; 2002; 2003.

Farkas J.: *Alapozás*
Műegyetemi Kiadó, 2000.

Szepesházi R..: Geotechnikai példatár
Tankönyvkiadó, 2000.

Atkinson, J.: *The Mechanics of Soils and Foundations*
Taylor and Francis, London, 2007.

Smoltczyk, U. ed.: *Geotechnical Enineering Handbook.,*
Ernst & Sohn, Berlin, 2003.

Mitchell, J. K., Soga, K.: *Fundamentals of Soil Behaviour,* John Wiley, 2005

Gradual research seminar

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	1.	practice mark	2	0 l+2 p	English

Subject leader and lecturer:

Name	Position	Department
Ferenc Mádai	Associate professor	Department of Mineralogy and Petrology

The main objectives of the subject:
Introduction to the methods and rules of information gatering and scientific communication in fields of earth sciences.

The short curriculum of the subject:
- Editorial requirements of scientific publications and abstracts,
- Referencing rules,
- Rules of citation, ethical questions of citation,
- Library usage, the screening of important journals,
- Internet-based scientific literature,
- Rules and requirements for oral presentations
- Tips and requirements for poster presentation
- "This is the way I do it" - opinions and advices of researchers on these topics,
- Analysis and elaboration of selected papers, oral and writing presentation on a selected topic.

References: textbooks and scientific journals in different fields of earth sciences

Quality management

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	exam	2	2l+0p	English

Name of subject:	**Quality Management**	Classification of subject:
Subject leader:	**Dr. Szintay István**	
Collaborator:	Dr. Berényi László	
Lectures: **D: 2+0/wk;**	Accomplishment: terminal examination	Credits: **2**

Preconditions:

Description of knowledge of the subject, abilities to develop:
The objective of the subject is to let he students know the story of quality management and the main toolset and models of quality assurance and quality management. Theoretical and practical knowledge will be taught to make the students able to bear the basis of ISO 900x standards, TQM and EFQM excellence evaluation.

Lectures:
1. History of quality-management. EU-vision of quality: excellence, competitiveness
2. 8 dimensions of quality. Terms of quality. Influence factors of quality. Cost of quality.
3. Quality standards. General overview. ISO 900x standards. Model of quality assurance. Solutions based on requirements.
4. ISO 9001 standard: Commitment of management. Processes.
5. ISO 9001 standard: HRM. Measurement. Development.
6. IST analysis. Documents of quality management. Connection with the organizational regulation system.
7. Environmental management systems. ISO 14000 standard, structure of EMAS.
8. Documentation of integrated management systems. Quality audit: typology and systems.
9. Terminology of TQM. The 3 pillars of TQM. TQM techniques.
10. Processes of CQI and Kaizen. Connection with general problem analysis and solution methods.
11. Organizational self-evaluation and quality management. Blocks of EFQM modell (Enablers).
12. Blocks of EFQM model (Results). Test and descriptive evaluation.
13. Integrated management model. Connection between EFQM and BSC.
14. Convergence of quality management solutions. Product signs.

Laboratories:
1. Meaning of quality. Definitions of quality. Costs of quality.
2. Video: QM in practice.
3. Documentation of ISO 90001: Structure of documentation system, analysis of ISO documents.
4. Documentation of ISO 90001: creating documents
5. ISO audit: preparations.
6. ISO audit: the process of audit.
7. ISO 14001: analysis of special documents
8. ISO 14001: creating documents
9. TQM in practice: The internal client (video)
10. Process management: process analysis, methods of modelling.
11. Process management: creating process by ARIS-method
12. Process management: anyalysis and development by ARIS
13. EFQM: preparing for self-evaluation
14. EFQM: preparing for external evaluation

Excersises, students work: Analysis of case-studies and situations.

Literature to study:
- Minőségmenedzsment I. Elmélet. Ed: Szintay I. Bíbor kiadó, Miskolc, 2005.

Advised literature:
- A.R. Tenner – I.J. De Toro: Teljeskörű Minőségmenedzsment. Műszaki Kiadó, Budapest, 1997.
- Juhász G. – Kornai T.: Környezetirányítási kézikönyv. Az agrárium környezetirányítási vezetői és környezetvédelmi megbízottai számára. Budapest, Szaktudás Kiadóház, 2002.
- Kövesi J. – Topár J.: Minőségmenedzsment alapjai. TYPOTEX, Budapest, 2006.

Legal and economic studies with regard to mining and geology

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	**exam**	2	2l+0p	English

Subject leader and lecturer:

Name	Position	Department
Hámor, Tamás Dr.PhD.	Invited lecturer, Ph.D.	MBFH, Department of Mineralogy and Petrology

The main objectives of the subject:
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

References:

Wagner H. et al. 2006: Minerals planning policies and supply practices in Europe – European Commission Directorate General Enterprise, University of Leoben, http://ec.europa.eu/enterprise/steel/index_en.htm

Hámor T. 2004: Sustainable mining in the European Union: The legislative aspect – Environmental Management, Vol. 33., pp. 252-261.

http://eur-lex.europa.eu/, http://www.mbfh.hu/hu/, http://www.eurogeosurveys.org/, http://www.euromines.org/

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

Tilton, J.E. *Exhaustible resources and sustainable development* 22 (1-2) Resources Policy 91 (1996)

Tóth M., Faller G. *Törvényszerűségek az ásványinyersanyaggazdaságban: Az ásványinyersanyag- és energiapolitika alakulását meghatározó természeti, technikai és gazdasági törvényszerűségek* (Akadémiai Kiadó, Budapest, 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.)

J. Otto (Ed); *The Taxation of Mineral Enterprises*, (Graham and Trotman/Kluwer, London, 1995)

Safety techniques and labour safety

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	**4**	exam	2	2l + 0p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Tibor Szabó	Assistant professor	Petroleum Engineering

Prerequisites: -

Course Objectives:

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.

Textbooks:

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 kiadvány2005.
A munkavédelmi törvény magyarázata, KJK KERSZÖV, 2005. ISBN 9632247752
Jogszabályok

Strategic management

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	4.	exam	2	2l+0p	English

Name of the subject:	Strategic Management		***Classification of the subject:*** KV
Responsible of the course:	István Szintay Ph.D. professor, institute director		
Participant instructors:	Csaba Deák Ph.D. associate professor István Kunos Ph.D. associate professor Aliz Somogyi assistant professor Márta Somogyi assistant professor		
Number of hours: 2+2 per week for full time students	**Requirement:** examination	Number of credits: 4	
Preliminarily conditions: -			
Knowledge to acquire, development of skills and ability: 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 ont he 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. Practice: Chapters of a business plan. Task assignment. Situational training: "Bank robbery". Conclusions. "The President" case study. Election of strategic leader. „Opel" case study. "Direction of a company – group" Strategical game I.-II. (software) Evaluations of public holdings (case study). Strategical alliance (case study). Industrial cluster (case study). Presentations of Business Plan.		
Requirements during the semester: Solving of tasks, creation of Business Plan.			
Compulsory reading: Szintay, I.: Stratégiai Menedzsment, Bíbor Kiadó, 2003. Tari, E.: Stratégiai szövetségek az üzleti világban, KJK, 1998. 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.			
Other remark: -			

Fluid mechanics

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	1.	exam	3	2l+1p	English

Subject leader and lecturer

Name	Position	Department
Prof. Dr. Elemér Bobok	Professor	Petroleum Engineering
Dr. Anikó Tóth	Assisstant prof.	Petroleum Engineering

The main objectives of the subject:
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.

References:
Bobok E.: Fluid Mechanics for Petroleum Engineers. Elsevier, Amsterdam, New York, Tokyo 1993.
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.

Hydrogeology

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	1.	exam	5	2l+2p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Péter Szűcs	associate professor	Department of Hydrogeology and Engineering Geology

The main objectives of the subject:
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 case-study problems.

References:
Dr. Juhász József: Hidrogeológia. Akadémiai Kiadó, Budapest, 2002.
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.

GW prospecting, water resources management

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	2.	exam	4	2l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Balázs Kovács	associate professor	Dept. of Hydrogeology and Engineering Geology

The main objectives of the subject:
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 filed and laboratory tests, geophysical, remote sensing methods and gives a "toolbox" for GW prospecting. The course gives an overview of the different GW occurrences, and of the problems of GW management. The students will be able to plan the protection of GW resources.
The students will get the fundamentals to be able to plan a GW prospecting work, to make decisions to reach the aim of the work planned.

The short curriculum of the subject:
Methodology and principles of groundwater prospecting. Geological, geotechnical, geophysical and remote sensing methods used in prospecting groundwater resources. 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 and planning the hydrogeological protection of GW. Practical work: self-made solutions of simple case-study problems.

References:
Fetter, C.W. (1988): Applied Hydrology, Merill, Carmel, California
Freeze, R.A. – Cherry, J.A. (1979): Groundwater, Prentice-Hall, Englewood Cliffs
Juhász J. (2002): Hidrogeológia, Akadémiai Kiadó, Budapest
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.
Neven Kresic (2007): Hydrogeology and Groundwater Modeling, CRC Press

Applied and engineering hydrology

Major	Semesters	Requirement	Credits	Class per week	Language
Hydrogeologist engineer MSc	2	Practice mark	2	1 lecture + 1 seminar	English

Teacher of subject and lecturer:

Name	Title	Department
dr. Lénárt László	assisstant professor	Hydrogeology and Engineering Geology

Scope of subject:
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. .

Brief syllabus:
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.

Course material:
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
Fáy Cs. (2001): A vízgazdálkodás áramlástechnikai berendezései, Környezetvédelmi Minisztérium.
Károssy Cs. (1999): Légkörtan I. Oskar kiadó.
Kontúr I. – Koris K. – Winter J. (1993): Hidrológiai számítások, Akadémiai kiadó.
Kozák M. – Bakonyi P. – Rátky I. – Horváth L. (1983): Hidraulika vízgazdálkodási szakmérnökök részére. Tankönyvkiadó.
Putarich I. V. (2006): Hidrológia. Apáczai Alapítvány, Újvidék.
Szász G. – Tőkei L. (1997): Meteorológia, Mezőgazda.
Urbanovszky I. (1998): Hidrológia és hidraulika, Környezetvédelmi Minisztérium.
Zsuffa I. (1996): Műszaki hidrológia, Műegyetemi kiadó. Tanszéki segédlet (műszaki irányelvek)

Water quality protection

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	2.	exam	3	11+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Péter Szűcs	associate professor, subject leader and lecturer	Department of Hydrogeology and Engineering Geology
Ferenc Sallai	invited lecturer	North Hungarian Environmental, Nature and Water Inspectorate, Miskolc

The main objectives of the subject:

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.

References:
Dr. Szűcs Péter és Sallai Ferenc (szerkesztők): Vízkészleteink természetes állapotának megőrzése. Jegyzet kézirat. 2006.
Dr. Pásztó Péter: Vízminőség-védelem, vízminőség-szabályozás. Veszprémi Egyetemi Kiadó, 1998.
Dr. Juhász József: Természet- és vízvédelem. Miskolci Egyetemi Kiadó, 1994.
Jolánkai G. (1997): Basic River Water Quality Models; Computer aided learning (CAL) programme on water quality modelling (WQMCAL version 1.1), UNESCO/IHP-V, Technical Documents in Hydrology, No. 13, UNESCO Paris p. 52 + software.

Jolánkai G. (1999): A vízminőség-védelem alapjai különös tekintettel a rendszerszemléletű ökohidrológiai módszerekre. Közreműködött: Bíró István. Egyetemi jegyzet. ELTE -TTK. pp. 1-139

The geophysics of exploration for water

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologyst engineer MSc	2	exam	5	2l+2p	Hungarian

Subject underwriter and lecturer:

Name	Position	Department
Dr. Endre Turai	Associate professor	Department of Geophysics

The main objectives of the subject:
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.

References:

Ádám O., Steiner F., Takács E.: *Bevezetés az alkalmazott geofizikába I.*
Tankönyvkiadó, Budapest, 1969. J14-1642
Kis B., Ferenczy L.: *Szénhidrogéntárolók mélyfúrási geofizikai értelmezése*
Nemzeti Tankönyvkiadó, Budapest, 1993.
George Asknith, David Krygowski: *Basic well-log analysis*
ISBN: 0-89181-667-4/2004.
Csókás J.: *Mélyfúrási geofizika*
Tankönyvkiadó, Budapest, 1989. J14-1568
Relevant publications in hungarian and english

Geotechnical Engineering

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologyst engineer MSc	2.	exam	4	2l+1p	English

Subject leader and lecture

Name	Position	Department
Dr. Imre Szabó	Professor, department head	Department of Hydrogeology and Engineering Geology

The main objectives of the subject:
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.

References:

Szabó Imre: Alapozás egyetemi jegyzet, Tankönyvkiadó, 1988

Ulrich Smoltczyk: Grundbau Taschenbuch, Ernst and Sohn Verlag, 1980

Bálint Julianna: Építőanyagok I.

Geotechnikai tervezés elvei és gyakorlata az EUROCODE 7 alkalmazásával

Dr. Bárczi István – Falu Gyula – Dr. Zalka Károly: Mechanika II. Szilárdságtan

Antal Ákos, Fazakas Zsolt, Szilvási Ferencné, Szűcs Sándor és Tápai Antal: Tartószerkezetek I. Vasbeton szerkezetek.

Dr. Bartos Sándor – Králik Béla: Mélyépítés II. I. kötet Földművek

Dulovics Dné, Králik B., Szabó T.(2004) : Közmű- és mélyépítés II.

Water chemistry

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	2.	pm	2	1l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. János Lakatos	associate professor	Department of Chemistry

The main objectives of the subject:
The students will be familiar with the structure and chemical properties and reactivity of water molecule, and will learn about the main principle of the equilibriums exist in aquatic system.

The short curriculum of the subject:
The structure of water molecule. The state diagram of water. Properties of ice, liquid water and steam. Supercritical state of water. Water as a solvent, polar character of water molecule. Solubility of gases liquids and solids in water. The dissociation of water. Acid-base equilibriums in water. Complexation and redox process in water. Water quantity and quality. Composition and main feature of natural waters. Production of different quality water: high purity water, soft water, desalination of water. Type of water contamination.

References:
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: Environmental Chemistry, 7.th ed. Lewis Publishers, 2000.

Hydrogeology of Hungary

Major	Semesters	Requirement	Credits	Class per week	Language
Hydrogeologist engineer MSc	2	exam	2	2 lectures + 0 seminar	English

Teacher of subject and lecturer:

Name	Title	Department
dr. Lénárt László	Assisstant professor	Hydrogeology and Engineering Geology

Scope of subject:
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.

Brief syllabus:
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.

Course material:

Almássy, E. – Buzás, Zs. (1999): Inventory of transboundary groundwaters. UN/ECE Task Force on Monitoring & Assessment under the Convention on the protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992) Lelystadt, September.

Juhász J. (1979): Műszaki földtani és vízföldtani tanulmányutak. Tankönyvkiadó

Juhász, J. (2002): Hidrogeológia. Akadémia, Budapest.

Korim, K. (1994): The hydrogeothermal systems in Hungary = International Association of Hydrogeologists Vol. 15. pp. 43-57.

Lénárt L. (1977, 1988)**:** Hidrogeológiai kirándulások a Bükkben. Tankönyvkiadó

Liebe, P. [Editor] (2003): Tájékoztatók hazánk felszín alatti vizeiről – Information on Groundwaters of Hungary, KvVM, CD, Budapest.

Lorberer, Á. (2002a): Hévízkészleteink és idegenforgalmi-balneológiai hasznosításuk = MGE.

Maucha, L. (1998): Az Agggteleki-hegység karszthidrológiai kutatási eredményei és zavartalan hidrológiai adatsorai 1958-1993VITUKI Rt. Budapest.

Somlyódy, L. [Editor] (2002): A hazai vízgazdálkodás stratégiai kérdései. (Strategic Issues of the Hungarian Water Resources Management) MTA, Budapest, 2002.

Szilágyi, G. – Böcker, T. – Schmieder, A. (1980): A Bükk-hegység regionális hidrodinamikai képe és karsztvízforgalma = Hidrológiai Közlöny, Vol. 60. No. 2. pp. 49-

Tóth, E. (2002): A Bükk hegység karsztvízkészlet-gazdálkodása. A bükki karsztvízkutatás legújabb eredményei c. konferencia. Miskolc, 2002. január. 24-26. Karsztvízkutatás Magyarországon II. 154-167. Miskolc.

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.

Drilling, Deep Drilling

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	p	2	1l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Imre Federer	associate professor	Petroleum Engineering Department

The main objectives of the subject:
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.

References:
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, 4th 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.

GW flow and contaminant transport modeling

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	2.	exam	5	2l+2p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Balázs Kovács	associate professor	Dept. of Hydrogeology and Engineering Geology

The main objectives of the subject:
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.

References:
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

Geothermics

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	exam	2	1l+1p	English

Subject leader and lecturer

Name	Position	Department
Prof. Dr. Elemér Bobok	Professor	Petroleum Engineering
Dr. Anikó Tóth	Lecturer	Petroleum Engineering

The main objectives of the subject:

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

References:

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.

Numerical methods in geotechnics (Optional subject group (1))

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	exam	3	2l+2p	English

Subject leader and lecturer:

Name	Position	Department
Dr László Sárközi	Senior scientific/ researcher	Hydrogeology–Engineering geology

The main objectives of the subject:
The students will be familiar with the basic types of constitutive laws of mechanics with special knowledge of geomaterials. Main points of the studies are concerned of the elastic-plastic behavior of soils and rocks taking the well known material equations into regard. A substantial part of the curriculum concentrates on the Finite Element Method with application for nonlinear problems. They will get information how to model practical geomechanical problems from points of mechanical investigation and how to apply the tools of computational techniques for example for determination of the expected deformation, strain, stress, strain energy density, load carrying capacity properties of given geomechanical structures.

The short curriculum of the subject:
Introduction into the theory of strength of materials. Basic variables and equations. Linear and nonlinear behavior. The most characteristic constitutive laws of geomaterials, namely the Mohr-Coulomb, the Drucker-Prager and the Cambridge Cam Clay material equations considering the Critical State Soil Mechanics theory as well. The importance of Numerical Methods in Engineering Mechanics, the Finite Element Method. Application for nonlinear, elastic-plastic problems. The incremental – Newton-Raphson iterational technique. Solution of practical problems, like foundations, slopes, embankments, tunnels etc, and show how to apply for validation of soil lab measurement.

References:
[1] Atkinson,John:'An Introduction on the Mechanics of Soils and Foundations / through Critical State Soil Mechanics'. Mc-Graw Hill , London(1995)
[2] Lancellotta, Renato:'Geotechnical Engineering'.A.A.Balkema/Rotterdam/Brookfield (1995)
[3] Craig,R.F.:'Soil Mechanics'Sixth edition.E&FN Spon,London and New York (1997)
[4] Wood, D.M.:'Soil Behaviour and Critical State SoilM mechanics'Cambridge University Press,Cambridge(1990)
[5] Gunn,M.J.:'A Review of Numerical Methods for the Analysis and Design of Soft Ground Tunnels'. Cambridge , Engineering department.(1981)

Mineral Deposits (Optional subject group (1))

Department/Specialization	Term	Requirement	Credit	Assessment of studies	Language
MSc in Hydrogeological Engineering Course	3	exam	3	2lecture+1training	Enlish

Tutor:

Name	Status	Department
Dr. János Földessy	Professor	Department of Geology and Mineral Deposits

The Objectives of the Course:

The purpose is to train the hydrogeological engineer student to become familiar with the types, compositon, structures of the mineral deposits, the genetic character and the spatial distribution of the enrichments and the hidrogeological, water-quality features with regard to the mine facilities.

Course content:

In this course the students get to know the concept of the mineral resources, the main types of the geological processes which form the raw materials. It reviews the main groups of the mineral commodities (ores, fossil fuels, construction mineral raw materials). It presents some important examples from each of the above groups. The course prepares the students to recognize the basic hidrogeological and pollution problems (for example the acid mine drainage) in connection with the raw materials concentration. It gives information about the geological, economical character of the more important raw material resources in the Carpathians.

During the training the students get to know the physical aspect of the mineral raw materials by studying samples, and the geological conditions by consulting with geological maps and sections. They visit a producing mine in order to know the hydrogeological works in connection with a working mineral extraction site.

Notes, books and publications:

Zelenka T., Foldessy J (2006): Mineral Deposits - Lecture notes (CD and internet version)

Robb, L., 2005, Introduction to Ore-Forming Processes: Blackwell Publishing Co., 373 p. (ISBN 0-632-06378-5).

Dunning F.W. and A.M. Evans, editors (1986): Mineral Deposits of Europe. Vol. 3. Central Europe, The Institute of Mining and Metallurgy and The Mineralogical Society, London, 1986, 355 pp

Hydrogeological interpretation

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	practice mark	2	11+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Péter Szűcs	associate professor, subject leader and lecturer	Department of Hydrogeology and Engineering Geology

The main objectives of the subject:

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.

References:
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.

Waterworks, water supply

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	2.	exam	3	1l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Balázs Kovács	associate professor, subject leader and lecturer	Department of Hydrogeology and Engineering Geology
György Ritter	Invited lecturer	Department of Hydrogeology and Engineering Geology

The main objectives of the subject:
The students will be familiar with the basic elements of modern waterworks and water supply. Based actual geodesy survey, 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 fireworks. The measurement of the water loss in the supply system. Requirements concerning the water quality. Pumps, pipes, water towers and their hydraulics.
Practical work: self-made solutions of simple case-study problems.

References:

Szikra Csaba: Vízellátás, csatornázás. Elektronikus jegyzet. Budapesti Műszaki és Gazdaságtudományi Egyetem.
Máttyus Sándor nyomán szerkesztette Tolnai Béla: Vízellátás. 2. kiadás. Budapest.

Water and waste water purification

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	practice mark	2	1l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. János Takácsr	Associate professorr	Department of Process Engineering

The main objectives of the subject:
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. Cleaning and purification technology for municipal and industrial waste water. Technology design.

References:

1. Dr. Takács János: Oktatási segédletek;
2. Papp Sándor – R. Kümmel: Környezetkémia, Tankönyvkiadó, Bp. 1992.;
3. Berecz Endre: Kémia Műszakiaknak. Tankönyvkiadó, Bp. 1991.;
4. Toxikológiai lexikon;
5. Kovács Margít: A környezetvédelem biológiai alapjai. Mezőgazdasági Kiadó, Bp. 1975.;
6. Hungarian and English textbooks, and Internet resources.

Environmental Risk Assessment and Remediation

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	exam	3	2l+0p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Tamás Madarász	Assistant professor	Dept. of Hydrogeolgy and Engineering Geology

The main objectives of the subject:
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, Hungarian legal background, various applications of RA methods, risk based target value and its determination, Case studies.

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

References:
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

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.

Watermining

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	exam	3	2l+0p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Tamás Madarász	Assistant professor	Dept. of Hydrogeolgy and Engineering Geology

The main objectives of the subject:
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.

References:

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

Environmental Geotechnics

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologyst engineer MSc	3.	exam	2	1l+1p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Imre Szabó	professor	Department of Hydrogeology and Engineering Geology

The main objectives of the subject:
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.

References:

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.

Dewatering in engineering problems (Optional subject group (2))

Barnch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	practice mark	3	1l+2p	English

Subject leader and lecturer:

Name	Position	Department
Farkas Sándorné Dr.	Invited lecturer	Department of Hydrogeology and Engineering Geology

The main objectives of the subject:

The students will be familiar with the basic elements of dewatering design and realization. Based on well-hydraulics calculations and geological and hydro-geological interpretation, the main properties of a working dewatering system can be determined by the students.

The short curriculum of the subject:
The aims and roles of dewatering systems. The required parameters for a properly working dewatering system. Dangers and risks concerning groundwater resources. Calculations concerning well hydraulics. Determination of the radius of a working dewatering well. Dewatering in mining and geotechnical practice. Interpretation of geological, geophysical and hydro-geological information. Predictions concerning groundwater level changes in the future.
Practical work: self-made solutions of simple case-study problems.

References:

Ajtay Z.: Bányavizek elleni védekezés
Műszaki Könyvkiadó Budapest, 1962
Schmieder-Kesserű-Juhász-Willems-Martos: Vízveszély és vízgazdálkodás a bányászatban
Műszaki Könyvkiadó Budapest, 1975
Kesserű Zs.: Vízvédelem oktatási segédanyag az 1999/2000. tanévre

Wellfield and groundwater resources protection (Optional subject group (2))

Section	Semester	Exam/ practicum	Credit	Lessons per week	Language
Hydrogeologist MSc	3.	practice mark	3	1l+2p	English

Subject leader and lecturer:

Name	Position	University department
László Dr Perger	Head of Department in Central Directorate for Water and Environment	Hydrogeology and Geological Engineering

Aims:
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.

Short draft of 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.

References
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

Remote sensing (Optional subject group (2))

Branch	Semester	Requirements (practice mark, exam)	Number of credits	Number of lecture and practice hours during a week	Language
Hydrogeologist engineer MSc	3.	practice mark	3	1l+2p	English

Subject leader and lecturer:

Name	Position	Department
Dr. Norbert Németh	junior lecturer	Dept. of Geology and Mineral Deposits

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

The short curriculum of the subject:
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).

References:
Thomas M. Lillesand – Ralph W. Kiefer 1987: Remote sensing and image interpretation. John Wiley & Sons, New York, 722p.
Dr. Sevcsik Jenő – Hefelle József 1980: Fényképészet. Műszaki Könyvkiadó, Budapest, 412p.
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.