University of Miskolc

Faculty of Earth Science and Engineering

Courses offered for ERASMUS students (2014/15 academic year)

FALL SEMESTER

SPRING SEMESTER

GEMAK712MA NUMERICAL AND OPTIMIZATION METHODS

Credits: 2
Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lec. and sem., 1+1
Type of Assessment (exam. / pr. mark. / other): pr. mark.
Position in Curriculum (which semester): first.
Pre-requisites (if any):-
Course Description:
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. Multiaided and multicriteria decision problems (Pareto efficient solutions). Linear programming. About Soft Computing (SC) methods: fuzzy systems, genetic algorithms, neural network. Numerical solutions of ordinary differential equations and system of equations: Runge-Kutta, predictor-corrector, finite differences.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Égertné, M. É., Kálovics, F., Mészáros, G.: Numerical Analysis I.-II. (Egyetemi jegyzet), 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.
- Course Managed by : Dr. Mészáros Józsefné, associate professor, PhD.

MFFTT710003 APPLIED GEOLOGY

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lec. 2, sem. 1**

Type of Assessment (exam. / pr. mark. / other): **exam**

Position in Curriculum (which semester): **first**

Pre-requisites *(if any)*:

Course Description:

The inner structure of Earth. Plate tectonics and hydrocarbon generation. Hydrocarbon-geological aspects of magmatic, sedimentary and metamorphic rocks. Generation of hydrocarbons. Primary and secondary migration. Characteristics of reservoirs. Porosity, permeability, the effects of grain size and sorting. Trapping mechanisms, trap types. Carbon-dioxide storage in geological reservoirs.

The **3-5** most important *compulsory,* or *recommended* **literature** (textbook, book) resources:

- Stoneley, R.: Introduction to Petroleum Exploration for Non-geologists. Oxford University Press, 1995, ISBN 0 19 854856 7
- Landes, K. K.: Petroleum Geology. John Wiley & Sons, 1959
- Pápay, J.: Development of Petroleum Reservoirs. Akadémiai Kiadó, 2003, ISBN 963 05 7927 8

Course Managed by : Dr. Éva Hartai, associate professor, PhD.

MFKGT710005 FLUID MECHANICS

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lec. 3**

Type of Assessment (exam. / pr. mark. / other): **exam.**

Position in Curriculum (which semester): **first.**

Pre-requisites *(if any)*:

Course Description:

Kinematics. Conservation of mass. Balance Equations of momentum. Perfect Fluid Flow. Euler's equation. Bernoulli equation. Elements of gas dynamics. Bernoulli equation with friction. Laminar and turbulent flow in pipes. Determination of pressure losses. Moody's diagram. Pressure losses in gas transporting pipe-lines.

The **3-5** most important *compulsory,* or *recommended* **literature** (textbook, book) resources:

- E. Bobok: Fluid Mechanics for Petroleum Engineers. Elsevier, Amsterdam, London, New York, Tokyo, 1993. ISBN: 10: 0-444-98668-5
- V. L. Streeter, E. B. Wylie, K. W. Bedford: Fluid Mechanics. WCB/McGraw-Hill 1998, ISBN 0-07-062537-9
- R. Bird, W. Stewart, E. Lightfoot: Transport Phenomena. John Wiley and Sons, New York, 2007. ISBN: 978-0-470-11539-8

Course Managed by : Dr. Anikó Tóth, senior lecturer, PhD.

MFGFT710005 APPLIED GEOPHYSICS

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week:

Type of Assessment (exam. / pr. mark. / other): **exam.**

Position in Curriculum (which semester): **first**

Pre-requisites *(if any)*:

Course Description:

The most important geophysical parameters used in HC exploration. Geophysical methods and their resolutions. Geophysical methods detecting HC in direct or Timelapse (including 4D) geophysical measurements. Physical bases and instrumentation geophysical measurements. The main features of wire line logging, logging production well logging. The determination of porosity, permeability, water and indicators of overpressured zones. Technical measurements and their applications. gained by logging in cased holes. Detecting well problems. Application of production and monitoring wells. Geophysical case histories including exploration

The **3-5** most important *compulsory,* or *recommended* **literature** (textbook,

- Sheriff R.E., Geldart L.P. : Exploration Seismology 2nd Edition, Cambridge New York, ISBN-10 0-521-46826-4, 1995.
- Bacon M., Simm R., Redshaw T.: 3-D Seismic Interpretation, Cambridge Cambridge, ISBN 978 0 521 71066, 2003.
- Serra O.: Well Logging and Reservoir Evaluation, Technip, Paris, ISBN 2007
- Schlumberger: Cased Hole Log Interpretation Principles/Applications, Schlumberger Services, Houston, 1989

Course Managed by : Dr. Gábor Pethő, associate res. professor, CSc, PhD.

MFKOT710002 DRILLING ENGINEERING I.

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lec. 3**

Type of Assessment (exam. / pr. mark. / other): **exam.**

Position in Curriculum (which semester): **first.**

Pre-requisites *(if any)*: **-**

Course Description:

The main subjects of the curriculum: introduction of the drilling rig components, the drilling process, the drill string elements, drill string design, drill string loadings, drill bits properties, drill bit selection, dull bit evaluation, drilling regime determination, drilling mud, mud engineering, solids control equipments, rig hydraulics, vertical and directional drilling techniques, bottomhole assembly design, the selection of the directional and horizontal well geometry, wellbore surveying, **s**urvey tool selection, the properties of mud motors, determination of fracturing gradient, casing shoe selection, casing design, factors affecting casing, biaxial forces determination in casing design, bending forces, running casing operations, unscheduled event during drilling operation.

The **3-5** most important *compulsory,* or *recommended* **literature** (textbook, book) 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.
- Drilling Data Handbook, Edítion Technip, Paris ISBN 2-2108-0756-4, 1999. 542 p.

Course Managed by : Dr. Imre Federer, associate professor, PhD.

Other Faculty Member(s) Involved in Teaching, if any **: Dr. Tibor Szabó, senior lecturer, PhD.**

MFKOT710004 RESERVOIR ENGINEERING FUNDAMENTALS

credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lec. 3**

Type of Assessment (exam. / pr. Mark. / other): **exam.**

Position in Curriculum (which semester): **first.**

Pre-requisites *(if any)*:

Course Description:

Short oil history. Properties of porous rocks. Darcy's law, permeability and its measurement. Saturations, and their measurements. Surface tension, capillarity and its measurement. The Leverett function. Relative permeabilities, and their measurement. Phase behavior of reservoir fluids. Single and multi component systems. Vapor-fluid equilibrium. Hydrocarbon gases, compressibility factor, gas viscosity. Oil properties, formation volume factor, viscosity. Convergence pressure. Differential and flash liberation. Volumetric estimation of hydrocarbons in place.

The **3-5** most important *compulsory,* or *recommended* **literature** (textbook, book) resources:

- Craft and Hawkins: Applied Petroleum Reservoir Engineering, Prentice Hall, 1991, ISBN 0-13-039884-5
- Towler: Fundamental Principles of Reservoir Engineering, SPE Textbook Series, Vol.8., 2002, ISBN 1-55563-092-8
- T. Ahmed: Advanced Reservoir Engineering, Gulf Publishing Co. 2005, ISBN-13: 978-0-7506-7733-2
- T. Ahmed: Reservoir Engineering Handbook, Gulf Publishing Co., 2001, ISBN 0-88415-770-9
- L. P. Dake: Fundamentals of Reservoir Engineering, Elsevier, 1978, ISBN 0-444-41830-X

Course Managed by : Dr. Tibor Bódi, associate professor, PhD.

MFKOT710005 PRODUCTION ENGINEERING FUNDAMENTALS

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lec. 3**

Type of Assessment (exam. / pr. mark. / other): **exam.**

Position in Curriculum (which semester): **first.**

Pre-requisites *(if any)*:

Course Description:

Properties of oilfield fluids and gases. Inflow performance of oil wells. Basics of single-phase flow: description and pressure drop prediction. Multiphase flow: basic concepts, flow patterns. Multiphase flow in oil wells: empirical correlations, mechanistic models, gradient curves. Accuracy of pressure drop calculations. Horizontal and inclined flow of multiphase mixtures. Multiphase flow through chokes. Temperature conditions in hydrocarbon producing wells. Theory of continuous flow and intermittent gas lifting, design of installations. Types of gas lift valves, their performance. Gas lift installation types, surface gas supply systems. Application of NODAL Analysis principles to gas lifted wells. Unloading of continuous flow gas lift wells, unloading valve string design.

The **3-5** most important *compulsory,* or *recommended* **literature** (textbook, book) resources:

- A.P. Szilas: Production and Transport of Oil and Gas. Part A., Akadémiai Kiadó, Budapest, 1986.
- Takács G.: Fundamentals of Production Engineering., textbook, Miskolci Egyetem, 2005. 161p.
- G. Takács: Gas Lift Manual., PennWell Corporation, Tulsa, USA. 2005. 478p, ISBN 0-87814-805-1.

Course Managed by : Dr. Gábor Takács, professor, PhD.

Other Faculty Member(s) Involved in Teaching, if any **: Dr. Zoltán Turzó, associate professor, PhD.**

MFKOT710006 TRANSPORT OF HYDROCARBONS

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lec. 3**

Type of Assessment (exam. / pr. mark. / other): **exam.**

Position in Curriculum (which semester): **first.**

Pre-requisites *(if any)*:

Course Description:

Hydraulics: Pressure drop in liquid and gas carrying pipelines. Thermodynamics: Temperature of oil in buried pipeline. Pressure loss calculation. Pipeline engineering: Determination of pipe diameters and thickness. Parallel lines, booster pumps. Pipeline construction. Centrifugal pumps and gas compressors: Series and parallel pumps, characteristic curves, control. Instrumentation: Pipeline and metering station instrumentation. Maintenance: Pipeline inspection and repairs, limits of imperfection. MAOP calculation.

The **3-5** most important *compulsory,* or *recommended* **literature** (textbook, book) resources:

- Szilas, A.P.: Production and Transport of Oil and Gas. Part A., Akadémiai Kiadó, Budapest, 1986.,
- ISBN 963-05-3363-4
- Szilas, A.P.: Production and Transport of Oil and Gas. Part B., Akadémiai Kiadó, Budapest, 1986.,
- ISBN 963-05-3938-1
- Kennedy, J. L.: Oil and Gas Pipeline Fundamentals, 1993. PennWell Books. ISBN 0-87814-390-4

Course Managed by : Dr. Zoltán Turzó, associate professor, PhD.

Other Faculty Member(s) Involved in Teaching, if any **: Dr. Gábor Takács, professor, PhD.**

MFKOT 710007 RESERVOIR LAB.

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lab.3

Type of Assessment (exam. / pr. mark. / other): pr. mark

Position in Curriculum (which semester): first

Pre-requisites (if any):

Course Description:

Practical measurements and calculations of petro physical and fluid parameters for optimal exploration of oil and gas reservoirs. Determination of initial hydrocarbons in place via volumetric and statistical methods. Objective of the course is to show laboratory equipment tha are able to determine those petro physical properties which influence production and fluid bearing capabilities of fluid bearing formations, along with calculation methods and their practical application. The course contains practical application of correlation methods which are able to calculate fluid phase behavior and pressure and temperature dependent properties like formation volume factor, density, viscosity, solution gas, etc.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

• J. Pápay: Development of Petroleum Reservoirs, Akadémiai Kiadó, Budapest 2003. ISBN 963 05 7927 8

• J Török, L. Fürcht, T.Bódi: PVTμ Properties of Reservoir Fluids. University of Miskolc, 1995

• C. H Whitson, M. R. Brule: Phase Behavior. SPE Monograph Volume 20. Richardon, Texas, 2000. ISBN:978-1-55563-087-4.

Course Managed by :Dr. Tibor Bódi, associate professor, PhD.

MFKOT710008 PRODUCTION TECHNOLOGY LAB. I.

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lab. 2

Type of Assessment (exam. / pr. mark. / other): pr. mark.

Position in Curriculum (which semester): first.

Pre-requisites (if any):

Course Description:

Calculations for the following topics: Properties of oilfield fluids and gases. Inflow performance of oil wells. Single-phase flow. Multiphase flow in oil wells: empirical correlations, mechanistic models, gradient curves. Horizontal and inclined flow of multiphase mixtures. Multiphase flow through chokes. Temperature conditions in hydrocarbon producing wells. Continuous flow and intermittent gas lifting. Unloading of continuous flow gas lift wells, unloading valve string design.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Szilas, A.P.: Production and Transport of Oil and Gas. Part A., Akadémiai Kiadó, Budapest, 1986., ISBN 963-05-3363-4
- Takács, G.: Fundamentals of Production Engineering., textbook, Miskolci Egyetem, 2005. 161p.
- Takács, G.: Gas Lift Manual., PennWell Corporation, Tulsa, USA. 2005. 478p, ISBN 0-87814-805-

1.

Course Managed by :Dr. Zoltán Turzó, associate professor, PhD.

Other Faculty Member(s) Involved in Teaching, if any :Dr. Gábor Takács, professor, PhD.

MFKOT710009 DRILLING DESIGN I.

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lab. 2

Type of Assessment (exam. / pr. mark. / other): pr. mark

Position in Curriculum (which semester): first

Pre-requisites (if any): -

Course Description:

The basic calculations related to the drilling rig components, the drilling process, Unit systems, the drill string design: drill string elements and their functions, typical BHA configurations, drill string design calculation. Hoisting: hoisting elements and their functions, drilling line design, ton miles calculation. Drill bits: design and classification of roller and diamond bits, dull bit evaluation, drill bit selection (drilling cost calculation). Vertical and directional drilling and related calculations. Casing design.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- H. Rabia: Oilwell Drilling Engineering. Principles and Practice. Graham Tratman Ltd. London 1995.
- Howard B. Bradley: Petroleum Engineering Handbook, Third Printing, Society of Petroleum Engineers, Richardson, TX, U.S.A. 1992.
- Drilling Data Handbook, Edition Technip, Paris ISBN 2-2108-0756-4, 1999.

Course Managed by :Dr. Tibor Szabó, senior lecturer, PhD.

Other Faculty Member(s) Involved in Teaching, if any :-Dr. Federer Imre, assistant professor, PhD.

MFKOT730010 COMPUTER APPLICATIONS II.

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: sem. 1 + lab. 2

Type of Assessment (exam. / pr. mark. / other): pr. mark.

Position in Curriculum (which semester): third.

Pre-requisites (if any):

Course Description:

Database management using Microsoft Access: user interface, elements of databases, relational databases. Creation of queries and reports. Database maintenance. General descriptions of CAD programs. Creation of simple engineering drawings using AutoCAD: user interface, drawing elements. Three-dimensional drawings. General descriptions of mathematical programs, Usage of MathCAD program: simple calculations, graphics, matrix operations, processing and analyzing measured data, programming, integral and differential calculations.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Actual User Manuals and online helps of the involved programs.

Course Managed by :Dr. Zoltán Turzó, associate professor, PhD.

MFKOT730011 ARTIFICIAL LIFTING II.

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lec. 3

Type of Assessment (exam. / pr. mark. / other): exam.

Position in Curriculum (which semester): third.

Pre-requisites (if any): Artificial Lifting I

Course Description:

Introduction to ESP operations: history, main features. Hydraulic, electrical backgrounds. Components and their operation: centrifugal pump, performance curves. Construction of the electric motor, operational features, starting. Temperature conditions of ESP motors. Functions and main parts of protectors. Construction and operation of gas separators. The downhole cable: construction, materials, operational features. Ancillary downhole equipment. Application of ESP units in special conditions. Producing high viscosity fluids. Production of gassy fluids: pump performance deterioration. Possible solutions: use of natural gas separation, gas separators, others. Abrasive, high-temperature fluid pumping. Variable speed drives: construction and operation of VSD drives. Design of ESP installations for low and high gas contents. Analysis of ESP system operation: NODAL Analysis. Energy conditions of ESP operation. Monitoring of system operation, typical failures, their elimination. Main features of PCP systems. System components: PCP pump, rod string, surface drives. Basics of PCP installation design.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Takacs, G.: Electrical submersible pumps manual. Elsevier, 2009. 425 p. ISBN 978 1 85617 557 9.
- Takács G.: Production technology 2. Univ. of Miskolc, 1991. 216p.
- Cholet, H.: Progressing cavity pumps. Editions Technip, Paris. 1997. 112p. ISBN 2-7108-0724-6.

Course Managed by :Dr. Gábor Takács, professor, PhD.

Other Faculty Member(s) Involved in Teaching, if any :Dr. Zoltán Turzó, associate professor, PhD.

MFKOT730013 EOR METHODS

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lec. 2

Type of Assessment (exam. / pr. mark. / other): exam.

Position in Curriculum (which semester): third.

Pre-requisites (if any):

Course Description:

To teach students production procedures, methods producing hydrocarbon reservoirs with higher recovery factor (EOR, IOR). To prepare students for inter disciplinary sciences and how to apply them to oil reservoirs. Hydrodynamic principles of oil displacement with miscible and immiscible fluids. Areal and edge flooding methods: well systems, displacement, areal and vertical displacement and volumetric efficiencies, and how they can be influenced. Enhanced Oil Recovery methods (EOR). Oil displacement by CO2 injection. Oil displacement by polymer flooding. Oil displacement with tensides, with polymertensides, with foam. Thermal methods like in-situ combustion (wet combustion), hot water injection, steam injection.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- J. Pápay: Development of Petroleum Reservoirs. Akadémiai Kiadó, Budapest 2003 ISBN 963 05 7927 8
- C. H Whitson, M. R. Brule: Phase Behavior. SPE Monograph Volume 20. Richardon, Texas, 2000. ISBN:978-1-55563-087-4.

Course Managed by :Dr. Tibor Bódi, associate professor, PhD.

MFKOT730014 WELL CONTROL LAB.

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lab. 3

Type of Assessment (exam. / pr. mark. / other): pr. mark

Position in Curriculum (which semester): third.

Pre-requisites (if any): -

Course Description:

Causes of kicks, warning signs of kicks, shutting-in procedures, the risk of shallow gas, stripping operation, pressure balance in the hole, behavior of gas in the well, well control methods, well control equipment, BOP stack arrangements, manifolds and valves systems, other devices, the functions and capacity of the accumulator unit, pressure testing of well control equipment, regulations and standards.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- T. Bell, D. Eby, J. Larrison, B. Ranka: Blowout Prevention, 4th Ed. ISBN 0-88698-242-1. 2009.
- R. Baker: Practical Well Control, 4th Ed. ISBN 0-88698-183-2. 1998.
- R. Grace: Blowout and Well Control Handbook, Gulf Publishing Company, ISBN: 0750677082.
- R. D. Grace: Advanced Blowout & Well Control, Gulf Publishing Company, 1994, ISBN 0-88415-260-X.

Course Managed by :Dr. Tibor Szabó, senior lecturer, PhD.

MFKOT730015 RESERVOIR MANAGEMENT SIMULATION LAB.

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lab. 3

Type of Assessment (exam. / pr. mark. / other): pr. mark.

Position in Curriculum (which semester): third.

Pre-requisites (if any): Flow in Porous Media

Course Description:

Definition of reservoir management. Short history. Basics of reservoir management. Goals. Realization. Monitoring. Evaluation. Case studies. Data acquisition and analysis. Material Balance calculations. Numerical simulation. Economic considerations. Risk analysis. EOR methods. Case studies.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Fanci: Principles of Applied Reservoir Simulation, Gulf Publishing Co. 2001, ISBN 0-88415-372-X
- Ertekin – AbouKassem - King: Basic Applied Reservoir Simulation, SPE Textbook Series, 2001, ISBN 1-55563-089-8
- T. Ahmed: Advanced Reservoir Engineering, Gulf Publishing Co. 2005, ISBN-13: 978-0-7506- 7733-2
- A. Satter: Integrated Petroleum Reservoir management: A Team Approach. Pennwell Books, 1994, ISBN 0-87814-408-0
- A. Satter: Computer Assisted Reservoir Management Pennwell Books, ISBN: 978-0-87814-777-9

Course Managed by : Dr. Tibor Bódi, associate professor, PhD.

MFKOT730016 NODAL ANALYSIS APPLICATIONS

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lab. 2

Type of Assessment (exam. / pr. mark. / other): pr. mark.

Position in Curriculum (which semester): third.

Pre-requisites (if any): Production Technology Lab II.

Course Description:

General introduction of NODAL Analysis programs. Building of the NODAL Analysis model. Testing of the model using field data. Using of the model for inspection, optimization and design. Connection to other simulators. Nodal Analysis of: flowing, gas lifted, sucker rod, electrical submersible or PCP pumped wells. Simulation and optimization of networks and gathering systems.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Beggs, H. D.: Production Optimization Using NODAL Analysis, OGCI Publications, 2003. ISBN: 0-930972-14-7
- Takács, G.: Gas Lift Manual., PennWell Corporation, Tulsa, USA. 2005. 478p, ISBN 0-87814-805- 1.
- Takács, G.: Sucker-rod pumping manual. PennWell, Tulsa 2003. 395 p. ISBN 0 87814 899 2
- Takács, G.: Electrical submersible pumps manual. Elsevier, 2009. 425 p. ISBN 978 1 85617 557 9.

Course Managed by : Dr. Zoltán Turzó, associate professor, PhD.

Other Faculty Member(s) Involved in Teaching, if any :Dr. Gábor Takács, professor, PhD.

MFKHT730017 HYDROGEOLOGY

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

Course Managed by

Name	Position	Department
Dr. Péter Szűcs	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.

MFEMECPP PARTICULATE PROCESSES

ECTS: 5
Responsible Instructor: Assoc. Prof. Ljudmilla Bokányi and Assoc. Prof. József Faitli

Contact Hours / Week: 5
Course Language: English
Expected prior knowledge: -
Course Contents:
Part – Mineral Processing Basics (Lj. Bokányi): Characterization of disperse systems. Particle size, shape, density and other physical parameters, their determination and mathematical distribution. Specific surface calculation and determination. Rheological properties of fluids and suspensions. Particle motion in fluids. Mineral intergrowth and liberation, determination of degree of liberation. Yield, assay and recovery. Washability curves. Separation efficiency and partition curve (Tromp-curve). Balance equations. Typical technological flow-sheets.
Part – Sampling (J. Faitli): Basics of engineering applied statistics, estimation of the theoretical features of a population by the empirical parameters of samples. Criteria for the random uniform mixture. The averaged single samples concept. The Gy sampling theory, fundamental sampling error, sampling nomograms. Necessary minimal mass of samples. Typical sampling tasks (bulk at rest and during motion, belt conveyors, one phase liquids and gases, multi phases flow in ducts and pipes, isokinetic sampling). Processing of the average sample and the analysis. Data reconciliation techniques. Case studies.
Part – Powder Dynamics (J. Faitli – Á. Rácz): General properties of bulk materials. Flow properties of powders. Comparison among viscous and powder flow. Measuring of powder flow functions, the Jenike type and the ring shear cells. Equipment of bulk storage, plug flow- and mass flow bins. Dischargers and feeders. Basics of pneumatic transport.

Study Goals: The aim of the course is the introduction into mineral processing, especially into particles related processing from the point of view of the characterization of raw materials and processing.

Education Method: Lectures, Laboratory Group Work, Field Trip

Literature and Study Materials:
- Wills, B.A.: Mineral Processing Technology. Third Edition. Pergamon Press, Oxford.
- Barry A. Wills, Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology
- Fuerstenau and Han (ed).: Principles of Mineral Processing, SME, 2003.
- Tarján, G. Mineral Processing, Volume I. Akadémiai Kiadó, Budapest, 1982.
- Laurila, M.J. – Corriveau, M.P.: The Sampling of Coal. Intertec Publishing.
- D. Schulze, Powders and Bulk solids – Behavior, characterization, storage and flow, 2008, Springer
- Faitli, J.: Sampling in Mineral Processing Plants. Manuscript.

Periodicals

Assessment: The assessment consists of a written report and presentation of the laboratory group work and a written exam.

MFEMECMP MECHANICAL PROCESSES

ECTS: 7

Responsible InstructorAssoc. Prof. Imre Gombkötő, Assoc. Prof. Gábor Mucsi

Contact Hours / Week: 7
Course Language English

Course Contents The course consists of the theory and practice of mechanical processes applied in mineral processing subdivided into the following parts:

Part – Crushing and Grinding (G. Mucsi): Characterization of the comminution process. Aim of comminution, evaluation of its result. Fundamentals of particle breakage. Fracture mechanics: deformation and fracture, formation and spreading of fracture. Comminution theories (Rittinger, Kick-Kirpicev, Bond). Comminution equipments: operating principle, technical parameters, fields of application (jaw crusher, gyratory crusher, cone crusher, impact crusher, hammer crusher, rolls crusher, tumbling mills, high pressure grinding rolls, ring mill, vibrating mill, stirred media mill, air jet mill).
Part – Classification (I. Gombkötő): Aim of physical separation processes, principles of screening and classification (screen performance, screen types, hydraulic classifiers, horizontal current classifiers, hydrocyclone), gravity concentration methods, operational parameters (principles, HMS, jigs, spirals, film concentrators and shaking tables, centrifugal concentrators).
Part – Gravity and Magnetic Separation (I. Gombkötő): Mechanisms and equipment for magnetic and electric separation techniques, operational parameters (principles, low-intensity magnetic separators, high-intensity separators, high-gradient magnetic separators, superconducting separators, high tension electrostatic and electro dynamic separators, eddy current separators).
Part – Sorting (S. Nagy): Miscellaneous separation methods (sorting, selective comminution).
Part – Agglomeration (S. Nagy): Aim of agglomeration, bonding forces, bonding mechanisms. Processes, characterization of products. Equipments of agglomaeration, granulation, pelletization, sintering and roll pressing.
Part – Dewatering (J. Faitli): Sedimentation. Coagulation and flocculation. The batch settling test and its evaluation. Equipment of solid – liquid phase separation, thickeners, filtration, dryers. Basics of process engineering design of dewatering technologies.

Study Goals The main goal of this course is to present the state of the art information about Mechanical processes of mineral processing, including comminution, mechanical separation and agglomeration processes and equipments, while the students will be able to comprehend the importance of application of the above techniques. Furthermore, the students will be able to do basic design of crushers, mills, separators and agglomeration and dewatering equipments and use their knowledge for optimization of mechanical processing technologies.

Education Method Lectures, seminars, laboratory classes, industrial visits

Literature and Study Materials: Handouts.
- List of recommended literature:

- Agba D. Salman, Mojtaba Ghadiri, Michael J. Hounslow: HANDBOOK OF POWDER TECHNOLOGY. Volume 12. Particle Breakage. 2007. ISBN: 978-0-444-53080-6
- A.D. Salmon, M. J. Hounslow, J.P.K. Seville: HANDBOOK OF POWDER TECHNOLOGY. Volume 11. Granulation. 2007. ISBN: 978-0-444-53080-6
- Barry A. Wills, Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology Books ISBN: 0750644508
- S. Komar Kawatra: Advances in Comminution. 2006. Society for Mining, Metallurgy, and Exploration, Inc. (SME) ISBN-13: 978-0-87335-246-8
- Gusztáv Tarján: Mineral Processing I-II., Tankönyvkiadó Budapest, 1974
- Wolfgang Pietsch: Size Enlargement by Agglomeration. 1991. JOHN WILEY & SONS ISBN 0 471 92991 3
- Wolfgang Pietsch: Agglomeration in Industry: Occurrence and Applications. 2005 WILEY-VCH Verlag GmbH & Co. KGaA ISBN 3-527-30582-3
- Errol G. Kelly, David J. Spottiswood Introduction to mineral processing Wiley, 1982

Periodicals, Description on case studies

Assessment Written exam.
Expected prior knowledge Mineral processing basics

MFEMECEG ECONOMIC GEOLOGY AND MINERALOGY

ECTS: 3

Responsible Instructor: Assoc. Prof. Éva Hartai
Contact Hours / Week: 2

Course Language: English
Expected prior knowledge: Physics, Chemistry, Geology and Petrography basics

Course Contents: Main rock forming minerals and mineral groups of silicates, oxides, carbonates. Genetic groups and main petrographic characteristics of rocks. Plate tectonics and ore formation. Basics of ore mineralogy. Optical properties and processing-related characteristics of the main ore mineral types. Application of electron probe microanalysis in ore mineralogy. Major ore forming processes. Magma-related ore deposits. Sedimentary and metamorphic ore deposits. Globally important types of ore deposits in a genetic system. Industrial minerals and their application.

Study Goals: Gaining basic knowledge on the processing-related mineralogical and geological aspects of ores and industrial minerals.

Education Method: ppt-supported lectures by the instructor; macroscopic examination of rocks, ore types and industrial minerals; ore microscopy; laboratory exercise; presentation by each students on a special ore deposit and the processing aspects of ores.

Literature and Study Materials: The slides will be provided digitally.

- MacKenzie, W. S., Guilford C. (1980): Atlas of Rock-Forming Minerals in Thin Section. Halsted Press
- Evans, A.M. (1993): Ore Geology and Industrial Minerals. An Introduction (Third edition). Geoscience Texts Series, Blackwell Scientific Publications, Oxford, 1–389.
- Bernhard Pracejus (ed.) (2008): The Ore Minerals Under the Microscope. An Optical Guide. Elsevier.
- Dill, H.G. (2010): The „chessboard" classification scheme of mineral deposits: Mineralogy and geology from aluminium to zirconium. Earth-Science Reviews, 100, 1–420.

Assessment: The assessment will be based on a written exam.

MFEGECMRD MINERAL RESOURCE DEFINITION

ECTS: 8

Responsible Instructor: Prof. János Földessy
Contact Hours / Week: 8
Course Language: English
Expected prior knowledge: Physical geology, Mineralogy, Petrography

Course Contents:
Part - Data Aquisition in geology and Exploration Methodologies (N. Németh): Field work: equipment and its usage. Basic documentation, maps and cross sections. Working strategies and rules in variable environments. Recording and data interpretation techniques. Extending the outcrops: data provided by remote sensing, drilling and geophysics. Sampling and assaying.
Part – Economic geology, Reporting of mineral reserves (J. Földessy, T. Hendricksen): Mineralogy / Petrology Review, Ore Deposit Formation / Modern Systems, Geochemistry / Isotopes / Fluid Inclusions, Magmatic Hydrothermal Systems, Ores in submarine environment of formation, Ores in Sedimentary Basins, Industrial Minerals, Resource Evaluation, Ore processing, Ore valuation/ore reserves, Instrumental mineral phase analysis and chemical analysis methods. Economic geology during mine closure.
Part – Resource modeling and definition (J. Molnár): Basic concepts of quantitative characterization of mineral reserves. Geometrical and numerical modeling of mineral reserves. Computational methods. Principal operations in numerical mineral resource modeling. Stochastic characterization of reserves. Visualization and docementation of modeling results. Valuation of reserves for mining purposes.
Part – Mineral processing basics (I. Gombkötő): Characterization of disperse systems. Physical parameters, their determination and mathematical distribution and their relevance. Mineral intergrowth and liberation, determination of degree of liberation. Yield, assay and recovery. Washability curves. Separation efficiency and partition curve (Tromp-curve). Balance equations. Typical equipments, their working principals and technological flow-sheets.

Study Goals: Gaining Basic Knowledge in Exploration geology; Resource assessment methods, treatment and management of mineral ore reserve in the economic analysis, mine design and production.
Students will be capable to run basic assessment of mineral resources, decide and evaluate measures focsing grade control. Introduction in planning and carrying out a data acquisition (exploration) campaign, field and laboratory work respectively.

Education Method: Lectures, laboratory and field exercises

Literature and Study Materials: The slides will be provided digitally, with complementary library literature search.

- Coe A. L: Geological Field Techniques. Wiley-Blackwell, 2010, 323 p.
- Sinclair A.J., Blackwell G.H.: Applied mineral inventory. Cambridge University Press, 2004, 401 p.
- Marjoribanks R.: Geological methods in mineral exploration and mining. Springer, 2010, 248 p.
- Edwards A.C. (ed.): Mineral Resource and Ore Reserve Estimation — The AusIMM Guide to Good Practice. The Australasian Institute of Mining and Metallurgy 2001, 639 p.

- Barry A. Wills, Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology
- Fuerstenau and Han (ed).: Principles of Mineral Processing, SME, 2003.
- Tarján, G. Mineral Processing, Volume I. Akadémiai Kiadó, Budapest, 1982.

Assessment: The assessment consists of an interim quiz, a written report and presentation of the laboratory group work and a written exam.

MFEGECEMG ENGINEERING AND MINING GEOPHYSICS

ECTS: 3
Contact Hours / Week: 3
Responsible Instructor(s): N. P. Szabó
Course Language: English
Expected prior: Mathematics, Physics, Geology

Course Contents: The course consists of the theory and practice of engineering and mining geophysical methods and geophysical data processing techniques. The material is subdivided into the following parts:
The classification of applied geophysical methods. General overview on the most important engineering, environmental, borehole and in-mine geophysical surveying methods. The basics and applications of gravity, magnetic, direct current geoelectric, electromagnetic and induced polarization, seismic, guided wave, borehole (well-) logging (lithology, porosity, saturation logs) methods. Special in-mine seam-wave- and seam-sounding methods.
Planning of geophysical surveys, geophysical data acquisition and processing, linear and global inversion methods.
Geological-, geotechnical-, environmental- and in-mine interpretation.
Field measurements, processing and interpretation of the collected geophysical data by commercial and special softwares developed by the Geophysical Department.

Study Goals: Fundamental understanding of applied geophysical methods. Introduction to selected chapters in applied environmental and underground in-mine geophysics. Gain experience in geophysical data acquisition, processing and interpretation.

Education Method: Lectures, seminars and field work.

Literature Materials:
- Kearey P., Brooks M. and Hill I., 2002: An Introduction to Geophysical Exploration. 3rd edition. Blackwell Science Ltd.
- Telford W. M., Geldart L. P. and Sheriff R. E., 1990: Applied Geophysics. 2nd Edition. Cambridge University Press.
- Blakely R. J., 1996: Potential theory in gravity and magnetic applications. Cambridge University Press.
- Ellis D. V. and Singer J. M., 2007: Well Logging for Earth Scientists. 2nd Edition. Springer.
- Serra O., 1984: Fundamentals of well-log interpretation. Elsevier.
- Menke W., 1984: Discrete Inverse Theory, Academic Press.

Scientific papers, Handouts.

Assessment: Report on the results of field work, written exam.

MFEGECERA ENVIRONMENTAL RISK ASSESSMENT AND GEOHYDROLOGY

Responsible Instructorprof. P. Szucs and Assoc. prof. T. Madarász
Course Language English

Expected prior Geochemistry (Bio, lithogeochemistry), geology, hydrology,

Course Contents Introduction to environmental risk assessment and its role in contaminated site remediation, as a part of it the course gives a strong emphasis on subsurface transport phenomena and their modelling to give a better understanding of how contaminants move in groundwater. Provides the basic knowledge of hydrodynamic and transport modeling and the practice of human health risk assessment. Keywords: basics of hydrogeology, groundwater flow systems, hydrodynamic and transport modeling, contaminant transport, site remediation, human health, adverse health effect, Risk, hazard terminology, risk assessment methodology, conceptual model construction, exposure assessment, exposure modeling, toxicology background, dose response relation, toxicological character of chemicals, carcinogen, threshold concept in toxicology, toxicological parameter for risk studies.

Syllabus of the course material:
1, Hydrogeology part: Darcy-law, flow and seepage equations. Flow systems under the surface. Groundwater as a geologic agent. Determination of hydraulic conductivity. Transport processes in groundwater. Basics of well hydraulics. Flow and transport modeling. Numerical simulations.
Definition of terms (hazard, risk, exposure, risk assessment, conceptual site model, contaminated land, etc.)
2. Risk assessment in various contexts, eg. geohazards; human health, ecological risk assessment
3. The detailed study of risk assessment framework related to human health
3.1.Elements of the risk assessment protocol Problem formulation (Hazard identification) (elements, steps, conceptual site model, relationship to site investigation)
Exposure Assessment (elements and steps of Exposure Assessment, the role of measurements and modeling, calculation of dose)
Hydrodynamic and contaminant transport modeling and its role in the RA procedure
Toxicity Assessment (elements, and steps, doze-response relationships, threshold and non-threshold chemicals, toxicological data, RfD, TDI, SF, etc, default assumptions in toxicity assessment)
Risk Characterization (Risk estimation and interpretation of risk values, description of uncertainties, HQ, ER, NCR, etc)
3.2. Case studies and simple risk calculations
3.3 Risk based performance assessment (applications and case studies,)
3.4. Risk assessment in contaminated site remediation, (roles and limitations, risk assessment ancontaminant specific target values)

Study Goals Understanding the basics of contamination transport processes and risk assessment . The students complete the course shall be able
1. to interpret human health risk assessment documentation
2. to complete simple risk assessment calculations
3. work together in a risk assessment team

4. understand the risk based remediation of contaminated land
5. understand risk based perform assessment
6. understand groundwater flow systems and subsurface transport processes

Education Method Lectures and involvement of simple practical calculations, forum and workshop tasks, web search and literature interpretations. During the hydrodynamic and transport modeling task they shall have hands on practice with modeling software

Literature and Study Materials Handouts and CD based course material. The lecturer shall refer to web materials, such as articles, online databases and tools that the students will be able to access and use for themselves in the future.
Charles R. Fits: Groundwater Science. Academic Press, 2002. pp. 1-450.

Assessment Written exam.

MFEGECUWM UNDERGROUND WASTE MANAGEMENT AND STORAGE

ECTS: 4

Responsible Instructor: Prof.Dr.-Ing. Helmut Wolff / Tech. University Berlin; Assoc. Prof. Éva Hartai

Course Language: English

Expected prior knowledge: Mechanics, Physics, Thermodynamics, General Mining

Course Content:

Part – Underground Waste Management (H. Wolff): UWM includes the scientific and technical work necessary to provide safe and economic means for long term waste management protecting men and environment from harmful effects of toxic substances. Industrial and radioactive wastes are differentiated, legal and economic aspects of waste disposal; basic risk assessment. Procedures and methods adopted to address future needs will be nation- or programme specific.

Part – Carbon Capture and Storage (É. Hartai): The carbon cycle. Effects of CO2 emission on climate. CO2 capture and transport. Reservoir characteristics, storage requirements. Transport of fluids in rocks. Physical, chemical and mineralogical trapping of CO2. Geological storage sites. Current CO2 storage activities. Risks and monitoring. Economics and legal aspects.

Study Goals:

Gaining basic knowledge in calculation and design of UWM-projects; capability to consider requirements in waste storage facilities; basic knowledge in economic considerations of waste handling and disposal; understanding of environmental impacts. Gaining basic knowledge on the geological aspects and environmental concerns of CO2 underground storage.

Education Method: Lectures, field trips.

Literature and Study Materials: The PPP and written teaching material will be provided digitally and partly as hard copy.

Assessment: The assessment consists of a written report and written exam.

MFEGECGE GEOTHERMAL ENERGY

ECTS: 4

Responsible Instructor: Prof.Dr.-Ing.Helmut Wolff / Tech.University Berlin

Course Language: English

Expected prior knowledge: Mechanics, Physics, Thermodynamics, Deep Drilling

Course Contents:

Global uses of geothermal energy; kinds of deposits; exploration- and exploitation – technologies; utilization of geothermal resources; conversion technologies e.g. direct heat use, heat and cold storage, electricity generation. Fundamentals and environmental aspects of ground source heat pump systems; heat exchangers. Environmental impacts. Specifics in geothermal deep drilling, directional drilling, casing and cementing. Economic consideration for geothermal drilling and production. The evaluation and presentation of a geothermal project is an integral part of the lecture.

Study Goals:

Gaining basic knowledge in geothermal energy resources and their economical application. Calculation and design of geothermal projects. Capability to consider requirements in near surface and deep geothermal production technologies; calculation and control production of heat and electricity. Understanding of environmental impacts in using geothermal energy.

Education Method: Lectures, project work, field trips.

Literature and Study Materials: The PPP will be provided digitally and partly as hard copy.

Assessment: The assessment consists of a written report including an oral presentation and written exam.

MFEGECMW MINE WASTE AND CONTAMINATED SOIL CHARACTERIZATION AND TREATMENT

ECTS: 6

Responsible Instructor: Dr. Ljudmilla BOKÁNYI PhD, CSc, Associate Professor, Dr. Ferenc MÁDAI PhD, Associate Professor, Dr. József FAITLI PhD, Associate Professor

Contact Hours / Week: 6
Course Language: English

Expected prior knowledge: Chemistry, Physics, Mathematics, Economic Geology and Mineralogy

Course Contents:
Part – Mine waste geochemistry and characterization (F. Mádai): Waste categories in the extractive industries, Acid Rock Drainage and Metal Leaching (ARD/ML); Sampling Plan, Objectives and Approach of mine waste sampling; Characterization methods: field methods, Static tests, Kinetic test; Interpretation and evaluation: Reaction Rates; Sulphate release; Oxygen Depletion; Leaching Rate; EU legal framework of mining waste management, best practices.
Part – Contaminated soil characterization and treatment (Lj. Bokanyi): Characterization of soils of different types. Typical organic and non-organic pollutants. Possible interactions between soil and pollutants. Processing systems for soil decontamination. Physical, biological, chemical and thermal techniques for soil treatment.
Part – Tailings Management (J. Faitli): Physical characterisation of tailings materials. Tailings transport and deposition technologies. Safety issues of tailings dams. Dilute-, dense- and paste slurry hydraulic transport systems. Case studies: Aznacollar, Verespatak, Kolontár.

Study Goals: Understand the importance of mining waste management for the mineral extraction industry; Detailed understanding of sulphidic ore weathering processes, ARD/ML; Have practice in main characterization and analytical tools; Understand the concept of mine waste sampling and management in different phases of the mining cycle, with special emphasis to tailings. Hav an understanding of different methods of soil remediation techniques.

Education Method: Lectures, Laboratory Group Work, Field Trip

Literature and StudyMaterials: The slides will be provided digitally.
- GARD Guide (www.gardguide.com),
- Walder I.F. & Schuster P.: Environmental geochemistry of ore deposits and mining activities. Short course notes, Albuquerque, New Mexico.
- Dold B.: Basic Concepts of Environmental Geochemistry of Sulfide Mine-Waste (UNESCO-SEG course material, 2005)
- Lapakko K.: Metal Mine Rock and Waste Characterization Tools: An Overview (International Institute for Environment and Development, 2002)

Assessment:The assessment consists of a written report and presentation of the laboratory group work and a written exam.

Semester	Requirements	Credit	Weekly hours	Language
fall	exam	4	2 L + 1 P	English

Course Managed by

Name	Position	Department
Dr. Mihály Dobróka and	Professor	Institute of Geodesy and Geophysics

Main objectives of the course:

Analysis of the applicability of near-surface and underground geophysical methods for geotechnical, engineering, geological, hydrogeological and environmental issues. Overview of special geophysical methods and their developmental trends.

Course Contents

Presenting of DC and AC geoelectrical, GPR, seismic guided wave, refraction and reflection methods for near-surface and in-mine applications. Processing and interpretation of measured geophysical data using individual- and joint inversion methods and tomography too in case of underground 1D, 1.5D, 2D and 3D models. Geophysical penetration sounding and applications. Studying the connection between geomechanical properties and geophysical parameters. Methods based in the synthesis and joint application of geophysical methods are learned by field and laboratory examples.

MFFTT710002E PHYSICAL GEOLOGY

Branch	Semester	Requirements	Credit	Weekly hours	Language
all branches	1	e	4	2 l+1 p	Hungarian, English

Course Managed by

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

Main objectives of the course:

The main objective of the course is to extend the students' knowledge in the geological approach of phenomena and processes in / on the lithosphere and make them be familiar with the reconstruction of the geological processes.

Short curriculum of the course:

The role of physical geology in the geological research and exploration. Principles of stratigraphy, stratigraphic nomenclature. Stratotype, litho- bio- and chronostratigraphy. Modern stratigraphic methods: magneto-, chemo, seismo-, sequence- and cycle-stratigraphy. Reconstruction of paleogeographic environments. Recognition end interpretation of rock-forming processes and tectonic events, determination of their succession.

Recommended bibliography:

- BARNES, C. W. (1988): Earth, Time and Life. John Wiley and Sons, New York
- SKINNER, B. J., PORTER, S. C. (1995): The Dynamic Earth. *John Wiley and Sons,* New York
- BROOKFIELD, M. (2006): Principles of Stratigraphy. *Blackwell Publishing,* New York

MFFAT710001E MINERALOGY AND GEOCHEMISTRY

Branch	Semester	Requirements	Credit	Weekly hours	Language
all branches	1	e	4	2 l+1 p	Hungarian, English

Course Managed by

Name	Position	Department
Dr. Sándor Szakáll	associate professor	Institute of Mineralogy and Geology

Main objectives of the course:

Students will get the knowledge of the principals of the distribution of chemical elements 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 deals with 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.

Short curriculum of the course:

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.

Recommended bibliography:

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

MFGGT710003E GEODESY, SPATIAL INFORMATICS

Semester	Requirements	Credit	Weekly hours	Language
spring	Exam	4	2L + 1P	English

Course Managed by

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:

- Quest: Geodesy Tutorial
- Vanicek,P.:Geodesy
  Burkard,R.K.: Geodesy for the Layman
- Short,N.: The Remote Sensing Tutorial

References are available for the students on CD.

MFGFT710004E APPLIED GEOPHYSICS I.

Branch	Semester	Requirements	Credit	Weekly hours	Language
all branches	1	e	4	2 l+1 p	Hungarian, English

Course Managed by

Name	Position	Department
Dr. Ákos Gyulai	professor	Department of Geophysics

Main objectives of the course:

to ensure suitable knowledge in surface geophysical methods and well logging in order to plan, carry out and interpret geophysical research/measurement after courses in data processing, inversion method and geophysical interpretation.

Short curriculum of the course:

Relationship between petrologic /rock physical and geophysical parameters. The solution of forward problem for 1D, 2D, 3D geological structures. Gravimetry, magnetic, electric, electromagnetic and seismic method in applied geophysics. Well logging methods. The interpretation methods of geophysical data.

Recommended bibliography:

- Sharma P.V. : Environmental and engineering geophysics, Cambridge Univ. Press, 1997
- Serra O. & L.: Well Logging data acquation and application, Serra Log, 2004

MFGFT710003E DATA AND INFORMATION PROCESSING

Branch	Semester	Requirements	Credit	Weekly hours	Language
all branches	1	p	4	2 l+1 p	Hungarian, English

Course Managed by

Name	Position	Department
Dr. Mihály Dobróka Dr. Endre Turai	university professor associate professor	Geophysical Department

Main objectives of the course:

Introducing students of Earth Science and Engineering to the basics of data and information processing.

Short curriculum of the course:

The principles of information theory. The theory of signals. The principles of data and information processing by means of inversion methods. Modeling, model types. Theoretical and measured characteristics. Error characteristic parameters in the data and the model space. The purport of local and global inversion methods. Spectral transformations (Fourier integral transformation, DFT, FFT, Z-transformation). Convolution, discrete convolution. Correlation functions, discrete correlation functions. Deterministic filtering. Image processing filters.

Recommended bibliography:

- M. Bath: Spectral Analysis in Geophysics, Elsevier Scien. Publ. Co., Amsterdam - Oxford - New York, 1974.
- Meskó: Digital Filtering, Akadémiai Kiadó, Budapest, 1984.

MFFAT720006 GRADUATE RESEARCH SEMINAR

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: sem. 2

Type of Assessment (exam. / pr. mark. / other): pr. mark.

Position in Curriculum (which semester): second.

Pre-requisites (if any): -

Course Description:

The purpose of the course – as in many different universities in the world – is to introduce the methods of information gatering 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.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Journals, texbooks, internet materials
- 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)

Course Managed by : Dr. Ferenc Madai, associate professor, PhD.

MFKOT720009 COMPUTER APPLICATIONS I.

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lab. 2**

Type of Assessment (exam. / pr. mark. / other): **pr. mark.**

Position in Curriculum (which semester): **second.**

Pre-requisites *(if any)*:

Course Description:

Hardware components of personal computers. Operating systems: General introduction of operating systems; Windows operating system: Usage of graphical user interface (GUI). Important system components. Hard disk maintenance. Installing new software and hardware components. Maintenance of software system. Computer networks: Local Area Networks, Wide Area Networks. Networking with Windows. Internet and intranets. Protocols: TCP/IP, FTP, HTTP. Electronic mail, mailing programs, WWW, Searching on the Web. General description of word-processing. Microsoft Word: creating and formatting simple documents. Writing and managing of longer documents (i.e. thesis). Useful tools of Word: spelling, thesaurus etc. Creation of presentations slides using Microsoft PowerPoint. General descriptions of spreadsheet programs. Microsoft Excel: creating and formatting tables and diagrams. Using equations: operators and built-in engineering functions. Writing user functions in Visual Basic programming language of Excel. Database management inside Excel: sorting, filtering and maintenance.

The **3-5** most important *compulsory,* or *recommended* **literature** (textbook, book) resources:

- Actual User Manuals and online helps of the involved programs.

Course Managed by : Dr. Zoltán Turzó, associate professor, PhD.

MFKOT720011 OILFIELD CHEMISTRY

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lec. 2, lab. 1
Type of Assessment (exam. / pr. mark. / other): exam.
Position in Curriculum (which semester): second
Pre-requisites (if any): Reservoir Engineering Fundamentals

Course Description:
Fundamentals of physical chemistry and colloid chemistry: behavior of real gases, equilibria, reaction kinetics, sorption phenomena, rheology, diffusion, colloid systems, surface and interfacial tension, capillary forces, wettability, properties of suspensions and emulsions. Chemistry of drilling muds and well completion fluids. Chemical well stimulation methods including hydraulic fracturing, acidization, profile control in water injection wells, chemical methods providing selective fluid flow in oil and gas producing wells (water shutoff treatments and GOR improving techniques). Fundamentals of intensive flooding technologies addressing the whole reservoir space. Chemical aspects of improved and enhanced oil and gas productions methods (IOR/EOR and IGR/EGR), including the thermal, gas injection and chemical (alkaline, surfactant and polymer) technologies. Mitigation of formation damage by chemicals, bottomhole clean-up for paraffin, asphaltene deposits, and chemical sand control in wells. Basics of water technology: composition of formation waters, mechanism of scale formation, their inhibition and removal of inorganic scales by chemicals. Surface and underground corrosion of metallic structures, types and origin of corrosion, corrosion inhibitors. Hydrocarbon hydrates and inhibition of hydrate formation at well site and transport pipelines.
The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Laider, K. J., Meiser, J. H.: „Physical Chemistry" Houghton Miffin Co., ISBN 0-395-91848-0, Boston (USA), 1999
- Atkins, P. W.: „Physical Chemistry", Oxford Univ. Press, ISBN 0-19-850102-1, Oxford (UK), 1998
- Green, D. W., Willhite, G. P.: „Enhanced Oil Recovery", SPE Inc., ISBN 1-55563-077-4, Richardson (USA), 1998
- Schechter, R. S.: „Oil Well Stimulation", Prentice Hall International, ISBN 0-13-949934-2, Englewood Cliffs (USA), 1992
- Jones, L. W.: „Corrosion and Water Technology for Petroleum Producers", Oil and Gas Consultants International Inc., ISBN 0-930972-09-0, Tulsa (USA), 1990

Course Managed by : Dr. István Lakatos, professor, Member HAS

MFFAT720006 GRADUATE RESEARCH SEMINAR

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: sem. 2

Type of Assessment (exam. / pr. mark. / other): pr. mark.

Position in Curriculum (which semester): second.

Pre-requisites (if any): -

Course Description:

The purpose of the course – as in many different universities in the world – is to introduce the methods of information gatering 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.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Journals, texbooks, internet materials
- 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)

Course Managed by : Dr. Ferenc Madai, associate professor, PhD.

MFKOT720012 PETROLEUM ECONOMICS

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lec. 2**
Type of Assessment (exam. / pr. mark. / other): **exam.**
Position in Curriculum (which semester): **second.**
Pre-requisites *(if any)*:
Course Description:
Brief summary of some general economic issues in macro-economics, micro-economics, company management (Porter's model) and decision theory. Basis of economic approach including cash flow modeling, time preference (concept of compound interest and present value). Forecast of key factors determining E&P business in the future. Methods determining key economic indicators. Features of appraisal individual projects applying economic indicators and their constraints in risk-free case. Basic geological, technical and economical features of petroleum industry investment in case of exploration, field development, production and abandonment (risks, resources, reserves, venture capital). Crude oil and natural gas price history and price forecasting models. Risks "measurements" and their impact on project value (expected value concept, Monte Carlo simulation). Evaluation uncertainty and risk of various parameter estimates and their impact on (economic) indicators calculated. Non-quantifiable (risk) factors and their impact on project evaluation. Assessment of project groups (portfolio evaluation). The place and role of oil companies worldwide: typical contracts and tax systems in various countries ranked in terms of hydrocarbon availability, profitability and risk.
The **3-5** most important *compulsory,* or *recommended* **literature** (textbook, book) resources:

- Seba, R.D. (1998): Economics of Worldwide Petroleum Production. OGCI Publications Tulsa, p.582
- Megill, R.E. (1984): An Introduction to Risk Analysis. PennWell Books Tulsa, p.274, ISBN 0878142576
- Brealey/Mayers (2003): Principles of Corporate Finance, McGraw-Hill ISBN: 0072467665
- D. Johnston (1992): Oil Company Financial Analysis in Nontechnical Language (Pennwell Nontechnical Series)
- SPE (2007): Petroleum Resources Management System http://www.spe.org/industry/reserves/docs/Petroleum_Resources_Management_System_2007.pdf

Course Managed by : Dr. Zsolt Komlosi, Advisor, PhD.

MFKOT720013 DRILLING ENGINEERING II.

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lec. 3
Type of Assessment (exam. / pr. mark. / other): exam.
Position in Curriculum (which semester): second.
Pre-requisites (if any): Drilling Engineering I.

Course Description:
The main subjects of the curriculum: wellbore stability, determination of rock properties, stress distribution around the wellbore, preventing borehole instability, primary cementing design, selection of cement and additives, cement slurry lab test, cementing calculations, effective mud removal, surface equipment and subsurface tools of cementing operation, two stage cementing operation, liner cementing, squeeze cement operation, cement job evaluation, foam cement applications, managed pressure drilling technology and surface equipment, mud logging, elements of well costing and affecting for well costing, drilling time estimate, drilling risk estimates, contracting strategies.

The 3-5 most important compulsory, or recommended literature (textbook, book) 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.
- Drilling Data Handbook, Edition Technip, Paris ISBN 2-2108-0756-4, 1999. 542 p.
- Erik B. Nelson: Well Cementing. Schlumberger Educational Services. Second Edition, Houston Texas, 2006

Course Managed by : Dr. Imre Federer, associate professor, PhD.
Other Faculty Member(s) Involved in Teaching, if any : Dr. Tibor Szabó, senior lecturer, PhD.

MFKOT720014 WELL COMPLETION DESIGN

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lec. 2/ lab. 1**

Type of Assessment (exam. / pr. mark. / other): **exam.**

Position in Curriculum (which semester): **second.**

Pre-requisites *(if any)*: **Drilling Engineering I.**

Course Description:

The main subjects of the curriculum: tubing string design, recommended torque for threaded coupling, tubing elongation, tubing movements, introduction of packer types, calculation of packer forces, connection between tubing and packer, well completion tools selection, perforating techniques, control the formation damage, well completion fluids, gravel pack techniques, formation stimulation, hydraulic fracturing, matrix acidizing, coiled tubing operations, wireline operations, nitrogen operations, well completion quality control.

The **3-5** most important *compulsory,* or *recommended* **literature** (textbook, book) 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.
- H. Dale Beggs: Gas production operation. OGCI Publications, Tulsa, 1984.
- Arthur Lubinski (Edited by Stefan Miska): Development of Petroleum Engineering I-II. Gulf Publishing Company, Houston, 1987.

Course Managed by : Dr. Imre Federer, associate professor, PhD.

Other Faculty Member(s) Involved in Teaching, if any **: Dr. Tibor Szabó, senior lecturer, PhD.**

MFKOT720015 FLOW IN POROUS MEDIA

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lab. 2
Type of Assessment (exam. / pr. mark. / other): pr. mark.
Position in Curriculum (which semester): second.
Pre-requisites (if any): Reservoir Engineering Fundamentals

Course Description:
Basic terms of porous media filtration. Continuity law. Governing equations of slightly compressible flow. Multiphase flow. Steady-state flow. Complex potential. Conformal mapping. Superposition. Non steady-state, transient flow. Immiscible, two phase flow, frontal oil displacement.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Craft and Hawkins: Applied Petroleum Reservoir Engineering, Prentice Hall, 1991, ISBN 0-13-039884-5
- Towler: Fundamental Principles of Reservoir Engineering, SPE Textbook Series, Vol.8., 2002, ISBN 1-55563-092-8
- T. Ahmed: Advanced Reservoir Engineering, Gulf Publishing Co. 2005, ISBN-13: 978-0-7506-7733-2
- T. Ahmed: Reservoir Engineering Handbook, Gulf Publishing Co., 2001, ISBN 0-88415-770-9
- L. P. Dake: Fundamentals of Reservoir Engineering, Elsevier, 1978, ISBN 0-444-41830-X

Course Managed by : Dr. Tibor Bódi, associate professor, PhD.

MFKOT720016 MATERIAL BALANCE

Credits: 4

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lec. 2, lab. 2
Type of Assessment (exam. / pr. Mark. / other): exam.
Position in Curriculum (which semester): second.
Pre-requisites (if any): Reservoir Engineering Fundamentals

Course Description:
Basic terms, conditions. Different forms of the material balance equation. Material Balance of the saturated oil reservoir. Average pressure. Drive mechanics, drive indices. Material balance equation of a gas reservoir. Water influx. Volumetric and open reservoirs. Cole and Campbell plots for gas and oil reservoirs. Hydrocarbon in Place Estimation with material balance. Havlena-Odeh, Tehrani, Sills methods. Prediction with material balance.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Craft and Hawkins: Applied Petroleum Reservoir Engineering, Prentice Hall, 1991, ISBN 0-13-039884-5
- Towler: Fundamental Principles of Reservoir Engineering, SPE Textbook Series, Vol.8., 2002, ISBN 1-55563-092-8
- T. Ahmed: Advanced Reservoir Engineering, Gulf Publishing Co. 2005, ISBN-13: 978-0-7506-7733-2
- T. Ahmed: Reservoir Engineering Handbook, Gulf Publishing Co., 2001, ISBN 0-88415-770-9
- L. P. Dake: Fundamentals of Reservoir Engineering, Elsevier, 1978, ISBN 0-444-41830-X

Course Managed by : Dr. Tibor Bódi, associate professor, PhD.

MFKOT720017 ARTIFICIAL LIFTING I.

Credits: 3

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lec. 3
Type of Assessment (exam. / pr. mark. / other): exam.
Position in Curriculum (which semester): second.
Pre-requisites (if any): Production Engineering Fundamentals

Course Description:
Introduction to artificial lifting: history, main features, comparison. Components of the sucker-rod pumping system: downhole pumps, sucker-rod string. Mechanical design of the sucker-rod string, failure modes. Surface equipment, pumping units, unit geometries, kinematics of pumping units. Gearboxes, prime movers. Calculation of operational parameters of rod pumping: approximate models. Dynamics of rod strings. The API RP 11L model: calculation accuracy, application ranges. Simulation of the sucker-rod string's behavior. Forms of the one-dimensional wave equation, solution methods, calculation of downhole cards. Torsional analysis of pumping units, optimum counterbalancing. Design of the pumping system, selection of the optimum pumping mode. Intermittent pumping. Analysis of the pumping system's operation: well testing, the use of dynamometers, evaluation of dynamometer cards.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:
- Takács G.: Basic sucker rod pumping. Miskolc, ME, 1992. 321 p.
- Takács G.: Sucker-rod pumping manual. Tulsa : PennWell, 2003. 395 p. ISBN 0 87814 899 2
- G. Takács: Modern sucker-rod pumping. Tulsa : PennWell, 1993. 230 p. ISBN 0 87814 383 1

Course Managed by : Dr. Gábor Takács, professor, PhD.
Other Faculty Member(s) Involved in Teaching, if any : Dr. Zoltán Turzó, associate professor, PhD.

MFKOT720010 PRODUCTION TECHNOLOGY LAB. II.

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lab. 2
Type of Assessment (exam. / pr. mark. / other): pr. mark.
Position in Curriculum (which semester): second.
Pre-requisites (if any): Production Technology Lab I.

Course Description:
Calculations for the following topics: Mechanical design of the sucker-rod string. Calculation of operational parameters of rod pumping: approximate models, the API RP 11L model, downhole cards. Torsional analysis of pumping units, optimum counterbalancing. Design of the pumping system, selection of the optimum pumping mode. Analysis of the pumping system's operation: well testing, the use of dynamometers, evaluation of dynamometer cards.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:
- Takács, G.: Sucker-rod pumping manual. PennWell, Tulsa 2003. 395 p. ISBN 0 87814 899 2
- Takács, G.: Electrical submersible pumps manual. Elsevier, 2009. 425 p. ISBN 978 1 85617 557 9.
- Takács, G.: Production technology 2. Univ. of Miskolc, 1991. 216p.
- Cholet, H.: Progressing cavity pumps. Editions Technip, Paris. 1997. 112p. ISBN 2-7108-0724-6.

Course Managed by : Dr. Zoltán Turzó, associate professor, PhD.
Other Faculty Member(s) Involved in Teaching, if any : Dr. Gábor Takács, professor, PhD.

MFKOT 720013 DRILLING DESIGN II.

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lab. 2
Type of Assessment (exam. / pr. mark. / other): pr. mark
Position in Curriculum (which semester): second
Pre-requisites (if any): -

Course Description:
The basics of fluids flow: flow regimes, fluid types, rheological parameters of fluids and measurement. Drilling mud: functions, types, drilling mud properties and additives, drilling mud calculations, solids control equipments. Rig hydraulics: pressure losses calculations, optimization of rig hydraulic, bit nozzle selection, determination of optimal flow regime. Fracturing gradient, Cementing: functions of cement slurry, cement types, cement classification, cement and cement additives, cement properties, cement design and calculations.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:
- H. Rabia: Oilwell Drilling Engineering. Principles and Practice. Graham Tratman Ltd. London 1995.
- Howard B. Bradley: Petroleum Engineering Handbook, Third Printing, Society of Petroleum
- Engineers, Richardson, TX, U.S.A. 1992.
- Drilling Data Handbook, Edition Technip, Paris ISBN 2-2108-0756-4, 1999.

Course Managed by : Dr. Tibor Szabó, senior lecturer, PhD.
Other Faculty Member(s) Involved in Teaching, if any : Dr. Federer Imre, assistant professor, PhD.

MFKGT740001 GEOTHERMAL ENERGY

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lec. 2, lab. 1
Type of Assessment (exam. / pr. mark. / other): pr. mark.
Position in Curriculum (which semester): fourth.
Pre-requisites (if any):

Course Description:
Geothermal energy phenomena. Geothermal reservoirs. Geothermal heat flow. Simple analytical reservoir models. Geothermal drilling practice. Well test analysis. Heat transfer in geothermal wells. Production from a geothermal well. Steam and hot water transmission by pipe-line. Direct application. EGS system. Sustainability and depletion. Geothermal heat pump. Environmental effects.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- R. Horne: Modern Well Test Analysis: A Computer-Aided Approach. Petroway, Inc., 1995, ISBN 0-9626992-1-7.
- J.W. Lund: Geothermal Direct-Use Engineering and Design Guidebook. Geo-Heat Center, Oregon Institute of Technology, 1998, ISBN 1-880228-00-9.
- E. Huenges: Geothermal Energy Systems: Exploration, Development, and Utilization. Wiley-VCH Verlag GmbH & Co. 2010. ISBN: 978-3-527-40831-3.
- D. Chnadrasekharam, J. Bundschuh: Geothermal Energy Resources. Sweet & Zeitlinger B.V. Lisse, Netherlands, 2002 ISBN 90-5809522-3

Course Managed by : Dr. Anikó Tóth, senior lecturer, PhD.

MFKOT740003 HSE IN PETROLEUM ENGINEERING

Credits: 2

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: lec. 2
Type of Assessment (exam. / pr. mark. / other): exam.
Position in Curriculum (which semester): fourth.
Pre-requisites (if any): -

Course Description:
Basics of fire and explosion protection. Fundamentals of combustion theories, burnings of different materials, auto ignitions. 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 labors 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.

The 3-5 most important compulsory, or recommended literature (textbook, book) resources:

- Design of plant, equipment and workplaces. Dangerous Substances and Explosives Regulations, 2003. ISBN 978 0 7176 2199 6
- Storage of dangerous substances./ Dangerous Substances and Explosive Regulations, 2003. ISBN 978 0 7176 2200 9.
- Dangerous Substances and Explosive Atmospheres Dangerous Substances and Explosive
- Atmospheres Regulations, 2003. ISBN 978 0 7176 2203 0
- Manufacture and storage of explosives Manufacture and Storage of Explosives Regulations, 2005. ISBN 978 0 7176 2816 2

Course Managed by : Dr. Tibor Szabó, senior lecturer, PhD.

MFKHT720015 GROUNDWATER FLOW MODELLING

Semester	Requirements	Credit	Weekly hours	Language
spring	exam	5	2l+2p	English

Course Managed by

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

Semester	Requirements	Credit	Weekly hours	Language
spring	exam	3	0 L + 2 P	English

Course Managed by

Name	Position	Department
Dr. József Molnár	Associate professor	Department of Mining and Geotechnics

Main objectives of the course:

Analysis of elements of underground mining systems and their operation. Students evaluate a special problem project supervised by the instructor.

MFFTT720001E STRUCTURAL GEOLOGY

Semester	Requirements	Credit	Weekly hours	Language
spring	exam	4	1 L +2 P	English

Course Managed by

Name	Position	Department
Dr. György Less Dr. Norbert Németh	Associate professor Junior lecturer	Institute of Mineralogy and Geology

Main objectives of the course:

To introduce the students to the representation of the spatial position and structure of the rock bodies, furthermore, the deformation processes and features concerning these bodies and their physical background.

Short curriculum of the course:

Subject of the structural geology and tectonics, basic concepts. Tools and techniques of representation and analysis: maps, cross sections, stereograms. Description of stresses in rocks and deformations caused by them. Material behaviour and the formed brittle and ductile deformation features. Informations about the inner structure of the Earth. Tectonic features, plate tectonics.

Recommended bibliography:

Németh Norbert: A szerkezeti földtan és tektonika alapjai [Basics of structural geology and tectonics]. Manuscript (electronical). University of Miskolc, 2005, 60 p.
Ramsay, J. G. & Huber, M. I: The techniques of modern structural geology. Vol. 1: Strain Analysis. Academic Press, London, 1983, 1-308 p.
Ramsay, J. G. & Huber, M. I: The techniques of modern structural geology. Vol. 2: Folds and Fractures. Academic Press, London, 1987, 309-700 p.
Ramsay, J. G. & Lisle, R. J: The techniques of modern structural geology. Vol. 3: Applications of continuum mechanics in structural geology. Academic Press, London, 2000, 701-1062 p.
Twiss, R. J. & Moores, E. M: Structural Geology. Freeman & Co., New York, 1992, 532 p.
Twiss, R. J. & Moores, E. M: Tectonics. Freeman & Co., New York, 1995, 415 p.

MFFTT720002E MINERAL DEPOSITS

Semester	Requirements	Credit	Weekly hours	Language
spring	exam	4	2 L + 1 P	English

Course Managed by

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

Main objectives of the course:

The purpose of the course is to train the Earth Science and Engineer students to be familiar with the structures of the mineral deposits, the character and the spatial distribution of the mineral enrichments furthermore the qualitative and quantitative features in connection with the mineral ore deposits.

Short curriculum of the course:

In the introduction the students review the main mineral groups (ores, industrial minerals, fossil fuels, construction minerals) and the history of their exploration and application.
The next part introduces the students to the main types of the geological processes and their way of appearance. It covers the genetic and practical grouping of the ore minerals. It gives particular details about domestic and global occurrences of the major deposit types, their metallogeny. It prepares the students to recognize the geological attributes, the rock alteration, and structural preparedness. At the end it shows the more important industrial minerals quarries in Europe and in the world.
During the practical training the students become familiar with the geological parameters of the ore, non-metallic and fossil fuel sites and their ways of appearance. They learn about the material characteristics of industrial minerals and determination methods of the chemical and mineral phases. The students get acquainted with reading, constructing of geological maps, profiles and 3D interpretation concerning the economic minerals. On the practical training they study exploration sites and active mines.

Recommended bibliography:

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.
Cox, D.P., Singer D.A (1987): Mineral Deposit Models. USGS Bulletin 1693. 379 p.

MFKHT720011E ENGINEERING GEOLOGY AND HYDROGEOLOGY

Semester	Requirements	Credit	Weekly hours	Language
spring	exam	4	2 L + 1 P	English

Course Managed by

Name	Position	Department
Dr. Péter Szűcs Krisztina Beáta Faur	Associate professor Engineer	Department of Hydrogeology and Engineering Geology

Main objectives of the course:

The students will be familiar with the basic concepts of engineering geology, modern hydrogeology as well as field hydrogeology. The students will study about the soil classification, soil formation, laboratory and on-site soil tests, the relationships of rocks and groundwater, and about the phenomena of groundwater flow through the pores and fractures.

Short curriculum of the course:

Soil formation. Soil classification. Laboratory and on-site soil tests. Dynamic geological processes. Engineering geological analysis of buildings and plants. Engineering geological mapping. Engineering geological aspects of environmental protection. 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.

Recommended bibliography:

David Daming: Introduction to Hydrogeology, McGraw-Hill Higher Education, 2002.
F. G. Bell: Engineering Geology, Oxford, Blackwell Scientific Publications, 1992
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.
Neven Kresic: Quantitative Solutions in Hydrogeology and Groundwater Modeling. Lewis Publishers, 1997.

MFFAT720002E ANALYTICAL TECHNICS IN MINERALOGY AND PETROLOGY

Semester	Requirements	Credit	Weekly hours	Language
spring	Practical mark	2	1 L +1P	English

Course Managed by

Name	Position	Department
Dr. Norbert Zajzon	Research fellow	Institute of Mineralogy and Geology

Main objectives of the course:

To give an introduction of the different analytical methods and instruments in mineralogy and petrology. The personal practice is an important part of the subject beside the theoretical knowledge. During these exercises, students can learn what kind of analytical technique could be used to solve a geological problem.

Short curriculum of the course:

Physical properties of minerals, hardness, cleavage, density measurement. Phase analysis, principle of the x-ray powder diffraction with individual practice. Theory of the differential thermal analysis, the thermogravimetry and the differential thermogravimetry with individual practice. Principles of the scanning electronmicroscopy, energy- and wavelength-dispersive x-ray microanalysis with individual practice. Data analysis, chemical formula calculations.

Recommended bibliography:

King M et al. (1993): Mineral Powder Diffraction File Search- and Databook. ICDD, USA.

MFFTT720003E HISTORICAL GEOLOGY

Branch	Semester	Requirements	Credit	Weekly hours	Language
Geological Engineer	2	e	4	2 l+1 p	Hungarian, English

Course Managed by

Name	Position	Department
Dr. György Less	associate professor	Department of Geology and Mineral Resources

Main objectives of the course:

The aim of the subject is to give knowledge (1) on the role of time in the geological processes, (2) on the different methods of age-determination, (3) on the structural evolution of the Earth and (4) on the history of life in the Earth with special emphasis on the utility of all these in prospecting raw materials.

Short curriculum of the course:

Basic principles of stratigraphy, litho-, bio- and chronostratigraphy. Different methods of stratigraphical correlation and their significance in raw material prospecting. Age-determining methods: biostratigraphy, radiometry, magnetostratigraphy, chemostratigraphy, event stratigraphy, sequence stratigraphy. Reconstruction of different palaeoenvironments and their application in raw materail prospecting. Different magmatic, metamorphic and sedimentary facies types. The geological time scale, the structural, climatological and biological evolution of the Earth during the Precambrian, the Paleozoic, the Mesozoic and the Cenozoic. The evolution of Homoidea.

Recommended bibliography:

Levin, H.L. (2006) – The Earth Through Time, 8th Ed., 616 p., Wiley
Barnes, C.W. (1988): Earth, Time and Life. John Wiley and Sons, New York
Brookfield, M. (2006): Principles of Stratigraphy. *Blackwell Publishing,* New York

MFFAT720003E HYDROCARBON GEOLOGY

Branch	Semester	Requirements	Credit	Weekly hours	Language
Geological Engineer	2	e	2	2 l+0 p	English

Course Managed by

Name	Position	Department
Dr. István Bérczi	Professor	Department of Geology and Mineral Resources

Main objectives of the course:

To give a general overview of the
terms and definitions;
geological investigation and evaluation methods in the Upstream value chain (prospecting, exploration, field development, production)

- basic skills to conduct hydrocarbon geological studies.

Short curriculum of the course:

The genesis of oil and gas deposits/fields: geodynamic background, fundamentals of organic geochemistry, primary and secondary migration.
Basin analyses and thereafter: phases and methods of prospecting and exploration.
After a discovery: put your field on stream (from the end of exploratipon to the commencement of the production.
Core description, lithofacies modelling, depth matching, seismic validation. Hydrocarbon Geology in the field development. Stratigraphic and tectono-sedimentological modelling.
Lithology, pore-structure, contacts: key issues in calculating resources, reserves.
Saturation anomalies and their interpretation.
Static (geological) modelling: pressure surveys, production, daily rates as a validation of the static model
Geological fundaments of the dynamic model: a deterministic and a probabilistic approach.
Integrated G&G studies: OOIP/GIIP/PIIP, resources reserves
Oil and Gas Provinces of the Globe: resources/reserves and the future supply.

Recommended bibliography:

Bérczi István: Reservoir Geology (Manuscript, MOL 2007)

MFFTT720004E GEOLOGICAL MAPPING

Branch	Semester	Requirements	Credit	Weekly hours	Language
Geological Engineer	2	p	4	1 l+2 p	Hungarian, English

Course Managed by

Name	Position	Department
Dr. György Less	associate professor	Department of Geology and Mineral Resources

Main objectives of the course:

The subject gives knowledge on the figuration of geological phenomena on topographic maps, on preparing geological maps, cross-sections, their legend and on assembling explanatory report.

Short curriculum of the course:

The aim of preparing geological maps. The geological map and its additional parts (geological cross-sections, stratigraphical columns and legend). Geological phenomena figured in the geological maps: lithostratigraphical units, structural chacteristics. Different types of geological boundaries and their recognition on the field. Orientation on the field with topographical map and with GPS. Documentation of field observations in the field booklet and on the topographical map. Preparation of covered and uncovered (without Quaternary deposits) geological map of an about 2 sq. km territory with one geological cross-section, with stratigraphical column and legend. Assembly of a short explanatory report (Introduction with technical data, Physiography, Previous geological investigations, Stratigraphy, Structural geology, Review of the geological development, Hydrogeology, Mineral raw materials, References).

Recommended bibliography:

Tearprock, D.J. & Bischke, R.E. (2002) – Applied Subsurface Geological Mapping with Structural Methods 2nd Edition, 846 p., Prentice Hall

MFFAT720004E SEDIMENTOLOGY

Branch	Semester	Requirements	Credit	Weekly hours	Language
Geological Engineer	2	p	2	1 l+1 p	English

Course Managed by

Name	Position	Department
Dr. István Bérczi	Professor	Department of Geology and Mineral Resources

Main objectives of the course:

To give a general overview of the
fundamentals of the sedimentology (weathering, transport, depositional environments, diagenesis);
the methods of sedimentological investigations (rock/core descriptions, textural-, mineralogical investigations, establishment of lithofacies matrix);
steps of building a sedimentological model.

Short curriculum of the course:

Sedimentology: a part and parcel of the Earth Sciences (scales and elements)
Processes of sedimentation (weathering, transport, deposition/precipitation)
Processes of diagenesis

- The geodynamic control on weathering, transport, deposition/precipitation, diagenesis
- The genesis, transport, deposition and diagenesis of clastic sediments
- Classification of the clastic sedimentary rocks
- Classification of the calcareous rocks
- Sedimentology of the fossil energy sources (coal, petroleum, uranium)
- Sedimentology of the ores and non-metallic minerals

Recommended bibliography:

Selley (2000): Applied sedimentology.- Academic Press, London

MFFAT720005E GEOCHEMICAL PROSPECTING METHODS

Branch	Semester	Requirements	Credit	Weekly hours	Language
Geological Engineer	2	p	4	1 l+2 p	Hungarian, English

Course Managed by

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

Main objectives of the course:

Introduction into a basic area of mineral exploration methods, including the theorethical background of geochemical sampling, the detailed discussion of different sampling and analytical methods, as well as the methods of data processing and interpretation.
Completion of a geochemical exploration project, including field sampling, sample preparation, data processing and interpretation is an important part of the course.

Short curriculum of the course:

Geochemical distribution of chemical elements in different rock types, Concept of the geochemical background. Delineation of a mineralization, a mineral deposit. Primary dispersion, methods of its exploration. Geochemical aspects of weathering. Secondary dispersion and methods of its exploration. Sampling methods, sampling standards. Soil surveys, vegetation and water surveys. Stream sediment sampling methods. Heavy minerals geochemistry. Major analytical methods. Data processing and statistical methods.

Recommended bibliography:

Reedman J.H.: Techniques in mineral exploration (Appl. Sci. Publ. London, 1979)
Kuzvart M., Böhmer M (1986): Prospecting and Exploration of Mineral Deposits. Elsevier, Amsterdam, 508 p. ISBN 0-444-99515-3

MFGFT720005E ENGINEERING AND ENVIRONMENTAL GEOPHYSICS

Branch	Semester	Requirements	Credit	Weekly hours	Language
Geophysical Engineer	2	p	4	2 l+1 p	Hungarian, English

Course Managed by

Name	Position	Department
Dr. Tamás Ormos	associate professor	Geophysical

Main objectives of the course:

Analysis of the applicability of near-surface geophysical methods for geotechnical, engineering geological, hydrogeological and environmental issues. Overview of special geophysical methods and their developmental trends.

Short curriculum of the course:

Presenting DC and AC geoelectrical, GPR, seismic guided wave and recent refraction seismic methods in the frame of near-surface geophysical method group. Individual and joint interpretation (individual and joint inversion, tomography) of measured geophysical data based on different physical bases and their application to 1D, 1.5D, 2D and 3D models. Geophysical penetration sounding and applications. Studying the connection between geomechanical properties of rocks and geophysical parameters. Methods based on the synthesis and joint application of geophysical methods are learned by field and laboratory examples.

Recommended bibliography:

Knödel, K., Krummel, H., Lange.: Geophysik (in series: Handbuch zur Erkundung des Untergrundes von Deponien) Springer, Heidelberg, 2005.
Butler, D.K. (ed): Near-Surface Geophysics (in series: Investigations in Geophysics, No. 13.) SEG, Tulsa, 2005.
Journals:
Different papers from Magyar Geofizika, Geophysical Transactions, The Leading Edge, First Break, Near Surface Geophysics, etc.
Work-help tutorials. Geophysical acquisition, data processing and interpretation softwares.

MFGFT720006E GEOPHYSICAL INVERSION

Branch	Semester	Requirements	Credit	Weekly hours	Language
Geophysical Engineer	2	e	4	2 l+2 p	Hungarian, English

Course Managed by

Name	Position	Department
Dr. Mihály Dobróka	professor	Geophysical

Main objectives of the course:

Geophysical students of Faculty of Earth Science and Engineering learn the modern inversion methods of reading out geological and geophysical information from the geophysical measurement data set.

Short curriculum of the course:

Linearizing the non-linear inverse problem. Linear inversion methods in case of over-, under- and mixed determined inverse problems. Regularization, weighting in data and model space, separately. Iteratively reweighted least squares method. Quality checking of estimated parameters. Solving the non-linear inverse problem by means of global optimization methods. Simulated Annealing and Genetic Algorithms method groups. The joint inversion procedure. Applications in case of different geophysical dat asets

Recommended bibliography:

W. Menke: Geophysical Data Analysis: Discrete Inverse Theory. Academix Press, Inc. ISBN 0.12.480820.5

MFGFT720007E APPLIED GEOPHYSICS II.

Branch	Semester	Requirements	Credit	Weekly hours	Language
Geophysical Engineer	2	e	4	2 l+1 p	Hungarian, English

Course Managed by

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

Main objectives of the course:

Introduce to the geophysical exploration methods of mineral raw materials and environmental analysis for MSc academic specialization in geophysical engineering.

Short curriculum of the course:

Geophysical methods for hydrocarbon exploration. Geophysical methods for water exploration. Geophysical methods for ore exploration. Geophysical methods for nonmetallic raw materials exploration. Geophysical methods for structure exploration. Geophysical methods for environmental analysis.

Recommended bibliography:

Kearey, Ph., Brooks, M., Hill, I.: An Introduction to Geophysical Exploration, Blackwell Publishing, 2004.
Educational handbooks,
Selected chapters of technical books and professional articles.