Contents

Research topic area: Geotechnical Systems and Processes

COURSE TITLE: Tunneling		
	Instructor/ Responsible department/institute: Dr. Géza Bohus, associate professor Institution of Mining and Geotechnical Engineering	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination

Description:

Conventional and special methods of shaft sinking. Initial methods of tunneling. Advantages and disadvantages of tunnels vs. other solutions. Similarities and dissimilarities of tunnels and mine drifts. Classification of tunnels, size, shape and location. Determining axis line of the tunnel. Geological and hydrogeological exploration. Cross section and support of the tunnel. Methods of tunneling, tunnel boring machines (TBMs) and mining methods. Primary cutting of rocks: mechanized and blasting methods. Protecting country rocks. Operations of tunneling. Auxiliary operations, ventilation and dewatering. Sealing. Special operations, e.g. cementation, freezing, etc. Maintenance. Safety measures, fire protection.

Compulsory or recommended literature:

Compulsory literature: Students of the subject receive their compulsory literature or the list of them from the instructor.

Recommended literature:

Blight, Geoffrey E.: Geotechnical Engineering for Mine Waste Storage Facilities. CRC Press, 2009. ISBN 9780415468282

Chen, W. F. (Editor-in-Chief): The Civil Engineering Handbook. CRC Press. Boca Raton – New York – London – Tokyo, 1995. ISBN 0-8493-8953-4

Hartman, Howard L. – Mutmansky, Jan M. – Ramani, Raja V. – Wang, Y. J.: Mine Ventilation and Air Conditioning. 3rd Edition. Blackwell Publishers (Wiley), 1997. ISBN 9780471116356

Hartman, Howard L. (Senior Editor): SME Mining Engineering Handbook I.-II.. 2nd Edition. Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1992.

Hustrulid, W. A. (editor): Underground Mining Methods. Society of Mining Engineers of the American institute of Mining, Metallurgical and Petroleum Engineers, Inc. New York, New York, 1982.

Persson, Per-Anders – Holmberg, Roger – Lee, Jaimin: Rock Blasting and Explosives Engineering. CRC Press, 1993. ISBN 9780849389788

Singh, Bhawani – Goel, R K: Tunnelling in Weak Rocks. Geo-Engineering Book Series, 5.

	Elsevier Science & Technology, 2006. ISBN 9780080449876

COURSE TITLE: Production Systems of Underground Mining

	Instructor/ Responsible department/institute: Dr. József Molnár, associate profrssor Institution of Mining and Geotechnical Engineering	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination

Description:

Geological models and measures of the mineral reserve as the basis of mine design. Effect of different characteristics, such as depth, seam thickness, faults, parameters of country rocks, mine hazards, etc. on the operation of the mine. Taking into account main parameters of the deposit in determining optimal mining technology. Characterization of different mining methods (underground, surface mining, in situ leaching, placer mining). Mine development, main properties of the developing systems. Permanent facilities of the mines. Excavating methods used in underground mines of coal, ore and nonmetallic minerals. Abandoning excavations of the mine. Mine waste disposal. Environmental friendly solutions of mining. Reclaiming mined out areas.

Compulsory or recommended literature:

Compulsory literature: Students of the subject receive their compulsory literature or the list of them from the instructor.

Recommended literature:

Cooper, Paul: Explosives Engineering. Blackwell Publishers (Wiley), 1996. ISBN 9780471186366

Hartman, Howard L. – Mutmansky, Jan M.: Introductory Mining Engineering. 2nd Edition. John Wiley & Sons, 2002. ISBN 9780471348511

Hartman, Howard L. (Senior Editor): SME Mining Engineering Handbook I.-II.. 2nd Edition. Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1992.

Hustrulid, W. A. (editor): Underground Mining Methods. Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc. New York,

New York, 1982.

Hustrulid, William A.: Blasting Principles for Open Pit Mining, Set of 2 Volumes. Volume 1: General Design Concepts, Volume 2: Theoretical Foundations. Taylor & Francis, 2005. ISBN 9789054104582

Mastalerz, Maria – Glikson, Miryam – Golding, Suzanne D.: Coalbed Methane: Scientific, Environmental and Economic Evaluation. Springer Verlag, 1999. ISBN 9780792356981

Persson, Per-Anders – Holmberg, Roger – Lee, Jaimin: Rock Blasting and Explosives Engineering. CRC Press, 1993. ISBN 9780849389788

COURSE TITLE: Geomechanics

Instructor/ Responsible department/institute:

Dr. Ákos Debreczeni, associate professor
Institution of Mining and Geotechnical Engineering

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Structure and classification of rocks. Physical properties of rocks (porosity, density, compressibility, consistency, linear and triaxial shrinkage) influencing their mechanical characteristics. Mechanical properties of rocks and laboratory tests, uniaxial, tiraxial, compression, tensile and shear tests and rheological measurements. Mechanical models of rocks and their characteristics, elastic, plastic, rheological properties. Conditions of elasticity and failure, curves and theory of failure. Mechanical properties of loaded rocks containing liquids and/or gases. Mechanical behavior of rock masses below horizontal surface, elastic and plastic state of stress. Surface subsidence and deformations resulted by decreasing water level. Stability and failure of rock masses below slopes, slipping and stability of fills, effect of water pressure.

Compulsory or recommended literature:

Compulsory literature: Students of the subject receive their compulsory literature or the list of them from the instructor.

Recommended literature:

Jeager, J. C., Cook, N. G. W. Zimmermann, R. W.: Fundamentals of Rock Mechanics, Blackwell Publishing, 2007. ISBN 9780632057597

Jaeger, C.: Rock Mechanics and Engineering, Cambridge University Press, 2009. ISBN 9780521103381

Pietruszczak, S.: Fundamentals of Plasticity in Geomechanics, CRC Press, 201. ISBN 9780415585163

Tang, Chun'An; Hudson, John A.: Rock Failure Mechanisms, CRC Press, 2010. ISBN 9780415498517

COURSE TITLE: Production Systems of Surface Mining		
	Instructor/ Responsible department/institute: Dr. József Molnár, associate professor Institution of Mining and Geotechnical Engineering	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Geological models and measures of the mineral reserve as the basis of mine design. Effect of different characteristics, such as depth, seam thickness, faults, parameters of country rocks, mine hazards, etc. on the operation of the mine. Taking into account main parameters of the deposit in determining optimal mining technology. Role of surface mining in the economic consideration of the whole mining sector. Types of mineral deposits, geometric elements of the slopes (e.g. benches, berms, ramps, etc.), stripping ratio. Types and opening of surface mines, operations, basic types of technology. Primary cutting methods, blasting and mechanized cutting. Hydromechanization. Selective cutting. Tasks and methods of haulage in surface mining. Waste disposal. Environmental friendly solutions of mining. Reclaiming mined out areas.	
	Compulsory or recommended literature: **Compulsory literature:** Students of the subject receive their compulsory literature or the list of them from the instructor. **Recommended literature:** Cooper, Paul: Explosives Engineering. Blackwell Publishers (Wiley), 1996. ISBN 9780471186366 Hartman, Howard L. – Mutmansky, Jan M.: Introductory Mining Engineering. 2nd Edition. John Wiley & Sons, 2002. ISBN 9780471348511 Hartman, Howard L. (Senior Editor): SME Mining Engineering Handbook I.-II.. 2nd Edition. Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1992. Hustrulid, William A.: Blasting Principles for Open Pit Mining, Set of 2 Volumes. Volume 1: General Design Concepts, Volume 2: Theoretical Foundations. Taylor & Francis, 2005. ISBN 9789054104582 Persson, Per-Anders – Holmberg, Roger – Lee, Jaimin: Rock Blasting and Explosives Engineering. CRC Press, 1993. ISBN 9780849389788	

COURSE TITLE: Intoduction To GIS

Instructor/Responsible department/institute:

Prof. Dr. Gábor Bartha, professor emeritus
Dr. István Havasi, associate professor
Department of Geodesy and Mine Surveying,
Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Hardware tools and computer networks. Operation systems. Data base systems. The elements of software development.

Terrestrial geodetic reference systems. Map projection systems. Modern geodetic methods in data capturing. Spatial information systems. Types of geo-data. Definition of geo-objects and their features. Various geo-models (vector, raster, and hybrid models).

General features of program systems. Overview and use of wide-spread program systems (ArcGIS, Quantum GIS, GRASS, ITR, FreeTR).

Geodetic data capture (terrain point positioning by traditional, satellite, and photogrammetric methods). Practices in program development (C++programming, SQL).

Basic practices in with spatial information program systems (ArcGIS, Quantum GIS, GRASS, ITR, FreeTR). Development of spatial information systems.

Compulsory or recommended literature:

István Havasi - Gábor Bartha: Introduction to GIS digital book: Introduction to Geo-informatics (pp. 10.5) (Gábor Bartha). Satellite Global Positioning Systems (pp. 67) (István Havasi)
http://digitalisegyetem.uni-miskolc.hu, University of Miskolc TÁMOP 4.1.2.-08/1/A-2009-0033 project, 2011.

John R. Jensen, Ryan R. Jensen Introductory Geographic Information Systems

Wolfgang Torge: Geodesy (2nd Edition) de Gruyter, Berlin – New York 1991.

Petr Vanicek-Edward Krakiwsky: Geodesy: The concepts, 2nd Edition, Amsterdam-New York-Oxford-Tokyo, 1986.

Jonathan Campbell, MIchael Shin, Essentials of Geographic Information Systems

Handbook on geographic information systems and digital mapping, United Nations Publications, 2000

COURSE TITLE: Transportation Systems and Logistics in Mining and Geotechnical Operations		
	Instructor/ Responsible department/institute: Zoltán Virág, PhD, associate professor Institute of Mining and Geotechnical Engineering	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Students have theoretical knowledge in the area of exact processes in projecting and problems solution of transport and handling machinery based on mathematical and physical principals, with application of specialised modern information technologies and processes, which means mainly knowledge of transported materials, transport machinery and equipment, and also creation of complex logistic systems. Obtained knowledge forms the basis for original thinking and enable participate in research. The understanding of principals, theories and methods corresponds to their position in management, leading and research.	
	Compulsory or recommended literature: Hartman (Howard L. (Senior Editor): SME Mining Engineering Handbook I.-II.. 2nd Edition. Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1992. Hustrulid, W. A. (editor): Underground Mining Methods. Society of Mining Engineers of the American institute of Mining, Metallurgical and Petroleum Engineers, Inc. New York, New York, 1982. Hartman, Howard L. – Mutmansky, Jan M.: Introductory Mining Engineering. 2nd Edition. John Wiley & Sons, 2002. ISBN 9780471348511 William A. Hustrulid, Mark Kuchta, Randall K. Martin: Open Pit Mine Planning and Design, 2006, ISBN 1466575123 William A. Hustrulid (Editor), Richard L. Bullock (Editor): Underground Mining Methods: Engineering Fundamentals and International Case Studies, 2001, ISBN 0873351932	

COURSE TITLE: Modeling and Valuation of Mineral Deposits and Reserves

Instructor/ Responsible department/institute:

Dr. József Molnár, associate professor
Institution of Mining and Geotechnical Engineering

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Basic characteristics of mining as mineral extraction activity. Geostatistical methods. Spatial (3D) numerical models of mineral deposits, distribution of parameters, characterized by vector-vector functions. Valuation and estimation of mineral reserves, feasibility analysis. Effect of natural and technological factors on profitability. Connection of mineral exploration, production and environmental protection and its optimization. Exploration and mining concessions. Mineral resource protection.

Compulsory or recommended literature:

Compulsory literature: Students of the subject receive their compulsory literature or the list of them from the instructor.

Recommended literature:

Chen, W. F. (Editor-in-Chief): The Civil Engineering Handbook. CRC Press. Boca Raton – New York – London – Tokyo, 1995. ISBN 0-8493-8953-4

Gentry, D. W. – O'Neill: Mine Investment Analysis. Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers Inc., New York, New York, 1984.

Hartman, Howard L. (Senior Editor): SME Mining Engineering Handbook I.-II.. 2nd Edition. Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1992.

Hustrulid, W. A. (editor): Underground Mining Methods. Society of Mining Engineers of the American institute of Mining, Metallurgical and Petroleum Engineers, Inc. New York, New York, 1982.

Primel, Louis – Tourenq, Claude: Aggregates. Geology, Prospection, Environment, Testing, Extraction, Specifications, Processing Plants, Equipment, Quality. Taylor & Francis, 2000. ISBN 9789054107958

Stein, Michael L.: Interpolation of Spatial Data. Some Theory for Kriging. Springer Series in Statistics, 1999. ISBN 9780387986296

COURSE TITLE: Construction Materials Mining

Instructor/ Responsible department/institute:

Dr. Géza Bohus, associate professor
Dr. József Molnár, associate professor
Institution of Mining and Geotechnical Engineering

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Main characteristics of mines extracting construction materials (e.g. aggregates, clay, etc.) and raw materials for the construction materials industry. Opening construction material mines. Mines, which are hidden from their surrounding area. Classification construction materials for their cutting resistance. Mechanized primary cutting. Blasting methods using long blastholes of great diameter, overburden blasts. Dimension (masonry and ornamental) stone mining. Equipment of construction materials mining, Transportation methods and roads. Multi-level mining, optimal bench height. Proper advancing direction of the mining operations, mine safety. Alluvial mining. Environmental effects, reclamation.

Compulsory or recommended literature:

Compulsory literature: Students of the subject receive their compulsory literature or the list of them from the instructor.

Recommended literature:
Chen, W. F. (Editor-in-Chief): The Civil Engineering Handbook. CRC Press. Boca Raton – New York – London – Tokyo, 1995. ISBN 0-8493-8953-4
Cooper, Paul: Explosives Engineering. Blackwell Publishers (Wiley), 1996. ISBN 9780471186366
Gentry, D. W. – O'Neill: Mine Investment Analysis. Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers Inc., New York, New York, 1984.
Hartman, Howard L. – Mutmansky, Jan M.: Introductory Mining Engineering. 2nd Edition. John Wiley & Sons, 2002. ISBN 9780471348511
Hartman, Howard L. (Senior Editor): SME Mining Engineering Handbook I.-II.. 2nd Edition. Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1992.
Hustrulid, William A.: Blasting Principles for Open Pit Mining, Set of 2 Volumes. Volume 1: General Design Concepts, Volume 2: Theoretical Foundations. Taylor & Francis, 2005. ISBN 9789054104582
Persson, Per-Anders – Holmberg, Roger – Lee, Jaimin: Rock Blasting and Explosives Engineering. CRC Press, 1993. ISBN 9780849389788
Primel, Louis – Tourenq, Claude: Aggregates. Geology, Prospection, Environment, Testing, Extraction, Specifications, Processing Plants, Equipment, Quality. Taylor & Francis, 2000. ISBN 9789054107958

COURSE TITLE: Ventilation and Air Conditioning of Underground Excavations

Instructor/ Responsible department/institute:

Dr. János Janositz, research fellow
Institution of Mining and Geotechnical Engineering

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Contaminants of the mine atmosphere. Gases, methane, gas outburst hazard. Characteristics of dusts. Dust explosion. Ways of prevention of gases and dust. Reasons and conditions of rock and gas outburst, forecast and prevention. Factors, influencing climatic conditions. Heat index, apparent temperature. Heat sources in mines, estimation of climatic parameters. Air conditioning, artificial cooling. Air flows in underground mines. Rules of flowing air in mine drifts. Aerodynamic resistance of drifts and its measurement. Ways of reducing resistance of drifts. Numerical and analogue modeling of complicated ventilation networks, analysis, control, computational methods of design. Ventilation equipment of underground mines. Depression measurement. Economic aspect of ventilation. Mine fires and their reasons. Endogenous fires, forecasting hazardous seams. Fire suppression.

Compulsory or recommended literature:

Compulsory literature: Students of the subject receive their compulsory literature or the list of them from the instructor.

Recommended literature:

Doyle, Barry: Hazardous Gases Underground. Applications to Tunnel Engineering, Civil and Environmental Engineering; 5. CRC Press, 2001. ISBN 9780824704834

Hartman, Howard L. – Mutmansky, Jan M. – Ramani, Raja V. – Wang, Y. J.: Mine Ventilation and Air Conditioning. 3rd Edition. Blackwell Publishers (Wiley), 1997. ISBN 9780471116356

Hartman, Howard L. – Mutmansky, Jan M.: Introductory Mining Engineering. John Wiley and Sons, Inc.

Hartman, Howard L. (Senior Editor): SME Mining Engineering Handbook I.-II.. 2nd Edition. Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1992.

Hustrulid, W. A. (editor): Underground Mining Methods. Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers, Inc. New York, New York, 1982.

Mastalerz, Maria – Glikson, Miryam – Golding, Suzanne D.: Coalbed Methane: Scientific, Environmental and Economic Evaluation. Springer Verlag, 1999. ISBN 9780792356981

COURSE TITLE: Stability and Support of Underground Excavations

Instructor/ Responsible department/institute: Prof. Dr. Zsolt Somosvári, professor emeritus Dr. Ákos Debreczeni, associate professor Institution of Mining and Geotechnical Engineering	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination

Description:

Underground excavations, mechanical state of rocks around circular shafts in general, elastic and plastic conditions of rocks. Mechanical state of elastic rocks around horizontal drifts of circular, elliptical, rectangular and combined cross sections. Support of drifts, characteristics and the role of support, determination the load bearing capacity of the support. Main properties of different roof supports, masonry supports, steel arches and bolts. In situ tests in rock mechanics, measurements of stress, loads, expansion of rocks and convergence, rock movements. Huge underground excavations made from environmental protection purposes: aspects of selecting location, valuation of discontinuations of the rocks, methods of excavations and their support.

Compulsory or recommended literature:

Compulsory literature: Students of the subject receive their compulsory literature or the list of them from the instructor.

Recommended literature:

Brady, B. H. G., Rock Mechanics For Underground Mining, Springer Verlag, 2012. ISBN 9789401165037

Hoek, E.; Kaiser, P.K.; Bawden, W.F.: Support of Underground Excavations in Hard Rock, Taylor & Francis, 2000. ISBN 9789054101864

Jaeger, C.: Rock Mechanics and Engineering, Cambridge University Press, 2009. ISBN 9780521103381

Kolymbas, Dimitrios: Tunnelling and Tunnel Mechanics, Springer Verlag, 2010. ISBN 9783642064364

Tang, Chun'An; Hudson, John A.: Rock Failure Mechanisms, CRC Press, 2010. ISBN 9780415498517

COURSE TITLE: Geo-information Systems (MFA416)		
	Instructor/Responsible department/institute: Prof. Dr. Gábor Bartha, professor emeritus Department of Geodesy and Mine Surveying, Institute of Geophysics and Geo-informatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Features and components of geo-information systems. Computerized description of the real world, process of model development. Reference systems of geometric data. Data capturing procedures, data resources. Technological background and data structure of geo-information systems. Operation possibilities in geo-information systems. Developing strategies of geo-information systems. Geo-information applications.	
	Compulsory or recommended literature: István Havasi - Gábor Bartha: Introduction to GIS digital book: Introduction to Geo-informatics (pp. 10.5) (Gábor Bartha). Satellite Global Positioning Systems (pp. 67) (István Havasi) http://digitalisegyetem.uni-miskolc.hu, University of Miskolc TÁMOP 4.1.2.-08/1/A-2009-0033 project, 2011. John R. Jensen, Ryan R. Jensen Introductory Geographic Information Systems Wolfgang Torge: Geodesy (2nd Edition) de Gruyter, Berlin – New York 1991. Petr Vanicek-Edward Krakiwsky: Geodesy: The concepts, 2nd Edition, Amsterdam-New York-Oxford-Tokyo, 1986. Jonathan Campbell, MIchael Shin, Essentials of Geographic Information Systems Handbook on geographic information systems and digital mapping, United Nations Publications, 2000	

COURSE TITLE: Global Positioning Systems (MFA417)

Instructor/Responsible department/institute: Dr István Havasi, associate professor Department of Geodesy and Mine Surveying, Institute of Geophysics and Geo-informatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination

Description:

Development of terrestrial geodetic reference systems (ITRF, WGS, EUREF). Reference systems used in Hungary, ground and picture surfaces connecting to them. Physical distance measurement. Development of radio-navigation systems. GNSS, Fundamental and augmentation systems. Structure and actual status of fundamental satellite positioning systems (NAVSTAR-GPS, GLONASS, Galileo, COMPASS /CNSS/. Satellite-Based and Ground-Based Augmentation Systems and their tasks.

Subsystems of the NAVSTAR-GPS (GLONASS). Operation principles of satellite receivers and their classification. Error sources of GPS distance measurement and role of satellite geometry (DOP-numbers). Positioning techniques (code and phase measurements). Observation procedures (static, semi-kinematic, kinematic, and RTK surveying methods.

Processing survey data. Coordinate-transformation. Evaluation of surveying results, their accuracy. International and national GPS networks. Navigation, GIS, and geodetic applications of GPS. The role of GPS in Earth sciences (in mining).

Compulsory or recommended literature:

István Havasi - Gábor Bartha: Introduction to GIS: Introduction to Geo-informatics (pp. 10.5) (Gábor Bartha), Satellite Global Positioning Systems (pp. 67) (István Havasi), digital book,
http://digitalisegyetem.uni-miskolc.hu, University of Miskolc TÁMOP 4.1.2.-08/1/A-2009-0033 project, 2011.

B. Hoffmann-Wellenhof-H. Lichtenegger, and J. Collins: GPS Theory and Practice. Springer Wien New York, 1992, ISBN 3-21183534-2.

István Havasi: Test measurements for the accuracy of absolute and relative GPS positioning, 12th ISM Congress, Conference Proceedings (pp. 142-146), Beijing, China, September 20-27th, 2004.

István Havasi: Fight for the third place of the stand - that is to say Galileo and Compass. Geosciences and Engineering: a Publication of the University of Miskolc, (ISSN: 2063-6997) 1: (2) (pp. 69-74) (2012);

István Havasi - Márton Györffy: The accuracy of DGPS surveys on the basis of test measurements with a Leica GS20 receiver Acta Montanistica Slovaca; ISSN 1335-1788, Volume 12 (2007), Special Issue 3/2007 (pp. 371-379).

Wolfgang Torge: Geodesy (2nd Edition) de Gruyter, Berlin – New York 1991.

Petr Vanicek-Edward Krakiwsky: Geodesy: The concepts, 2nd Edition, Amsterdam-New York-Oxford-Tokyo, 1986.

COURSE TITLE: Maintance and Diagnostics (MFA418)

	Instructor/ Responsible department/institute: Gábor Ladányi, PhD, associate professor Institute of Mining and Geotechnical Engineering	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Basic theories of the maintenance. Methods for getting information about machine. Measuring vibration for diagnosing. Vibration sensors, and its application. Vibration parameters. An introduction of Fourier analysis, and the spectrums. Producing spectrums by filter analysis. Basic symptoms of machine faults. Methods for differentiate the different faults. Other methods using in fault diagnostic: sensing infra radiation of the machines, oil diagnostic, ultrasound diagnostic.Special measuring method for diagnosing induction motors. The current diagnostic of cage type induction motors.	
	Compulsory or recommended literature: Peter Tavner, Li Ran, Jim Penman, Howard Sedding:Condition monitoring of rotating electrical machines Brüel & Kjaer: Mechanical Vibration and Shock Measurements R. Keith Mobley:Maintenance Engineering Handbook (McGRAW-HILL)	

COURSE TITLE: Modern Survey Techniques in Geodesy and Mine Surveying		
	Instructor/Responsible department/institute: Dr. István Havasi, associate professor Department of Geodesy and Mine Surveying, Institute of Geophysics and Geo-informatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Modern total stations and geodetic data capture with them. Digital levels and their application. Satellite global positioning systems. GPS surveying and observation procedures. Laser instruments and their role in geodesy and mining. Ultrasonic survey instruments and their mining use. Laser scanning and its application possibilities in mining. Drones in open pit mines, instruments, surveying, and processing. Application of mobile mapping tools in earth sciences.	
	Compulsory or recommended literature: István Havasi - Gábor Bartha: Introduction to GIS: Introduction to Geo-informatics (pp. 10.5) (Gábor Bartha), Satellite Global Positioning Systems (pp. 67) (István Havasi) digital book, http://digitalisegyetem.uni-miskolc.hu, University of Miskolc TÁMOP 4.1.2.-08/1/A-2009-0033 project, 2011. B. Hoffmann-Wellenhof-H. Lichtenegger, and J. Collins: GPS Theory and Practice Springer Wien New York, 1992, ISBN 3-21183534-2. Wolfgang Torge: Geodesy (2nd Edition) de Gruyter, Berlin – New York 1991. Petr Vanicek-Edward Krakiwsky: Geodesy: The concepts, 2nd Edition, Amsterdam-New York-Oxford-Tokyo, 1986.	

COURSE TITLE: Rock Mechanics		
	Instructor/ Responsible department/institute: Prof. Dr. Zsolt Somosvári, professor emeritus Institution of Mining and Geotechnical Engineering	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Model of rock and its material structure basis. Elements of model of rocks, system of rocks in rock model. Theoretical basis of rheological phenomena. Mechanical equations of state. Material equations of rocks for approximation. Basic rheological equations of rock continuum, ways of their solution. Unified theory of rock continuums. Energodynamic basis, balance equations of mechanical processes. Material theory of rocks. Plastic condition and failure of materials systems. Material theory of rocks in their elastic condition. Plastic condition of rocks. Material theory of rocks in their plastic condition. Failure of rocks.	
	Compulsory or recommended literature: **Compulsory literature:** Students of the subject receive their compulsory literature or the list of them from the instructor. **Recommended literature:** Brady, B. H. G., Rock Mechanics For Underground Mining, Springer Verlag, 2012. ISBN 9789401165037 Fjar, Erling; Holt, R. M.; Raaen, A.M.; Risnes, R.; Horsrud, P.: Petroleum Related Rock Mechanics, Elsevier Science & Technology, 2008. ISBN 9780444502605 Jaeger, C.: Rock Mechanics and Engineering, Cambridge University Press, 2009. ISBN 9780521103381 Jeager, J. C., Cook, N. G. W. Zimmermann, R. W.: Fundamentals of Rock Mechanics, Blackwell Publishing, 2007. ISBN 9780632057597 Wittke, Walter: Rock Mechanics Based on an Anisotropic Jointed Rock Model (AJRM), Wiley-VCH, 2014. ISBN 9783433030790	

COURSE TITLE: Waste Disposal in Underground Excavations

Instructor/ Responsible department/institute:

Dr. Ákos Debreczeni, associate professor
Institution of Mining and Geotechnical Engineering

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Requirements of characteristics of country rocks. Qualification of new or abandoned excavations. Classification and qualification of wastes to be disposed. Radioactive and toxic wastes. Classes of wastes which are allowed to be disposed in determined types of geological formations. Final and temporary disposal of wastes. Natural and artificial seals, closure of storing chambers. Requirements of quality assurance of waste storage. Parameters to be taken into account and their measurement. Loading, hauling and storing wastes. Comparison of different methods of disposal from economical and risk aspect.

Compulsory or recommended literature:

Compulsory literature: Students of the subject receive their compulsory literature or the list of them from the instructor.

Recommended literature:

Blight, Geoffrey E.: Geotechnical Engineering for Mine Waste Storage Facilities, CRC Press, 2009. ISBN 9780415468282

Hudson, John; Harrison, John: Engineering Rock Mechanics - an Introduction to the Principles, Elsevier Science & Technology, 2000. ISBN 9780080438641

Wittke, Walter: Rock Mechanics Based on an Anisotropic Jointed Rock Model (AJRM), Wiley-VCH, 2014. ISBN 9783433030790

Amadei, B.; Stephansson, O.: Rock Stress and Its Measurement, Springer Verlag, 2012. ISBN 9789401062473

COURSE TITLE: Measurement and Automation

Instructor/ Responsible department/institute:

Gábor Ladányi, PhD, associate professor
Institute of Mining and Geotechnical Engineering

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Sensors are used for measuring non electrical quantities (pressure, force, torque, temperature, displacement, speed, acceleration the last three also in flowing fluid and gas). Principles of transformations are used in this sensors. Regarding of sensors we focus to the measuring technic of strain gauge.

Students can studying in their hands of own every sensors, measuring amplifiers, data acquisition boards were speaking about.

We give the most important parameters of sensors and data converters and the typical structure of measuring chain and its analog components. (signal conditioning units, sample and hold units, multiplexers)

DC and carrier frequency amplifiers, its advantageous and disadvantageous properties, fields of application.

Comparing the world of analog and digital signals. Rule of sampling, quantization.

A/D (analog/digital) and D/A converters, its important parameters, we need to know for proper select. Frequently used conversions principles of A/D converters.

Basics of serial digital signal transmission.

Getting started to a measuring data acquisition system. (Spider8-Catman; NI-LabView)

Compulsory or recommended literature:

ANALOG DEVICES: Data Acquisition Components and Subsystems

Robert G. Seippel: Transducers, Sensors and Detectors. Reston Publishing Co.

R. Schicker, G. Wegener: Measuring torque correctly; Hottinger Baldwin Messtechnik GmbH, 2002

KEITHLEY: Data Acquisition and Control Handbook (A guide to hardware and software for computer-based measurement and control)

Karl Hoffmann: An Introduction to Measurement using Strain Gages, Hottinger Baldwin

Brüel and Kjaer: Piezoelectric Accelerometers and Vibration Preamplifiers. (Theory and application handbook.)

COURSE TITLE: Engineering Surveys and Mine Surveying

Instructor/Responsible department/institute:

Dr. István Havasi, associate professor
Department of Geodesy and Mine Surveying,
Institute of Geophysics and Geo-informatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

The purpose and tasks of engineering surveys. Classification, planning, and establishment of survey networks. Traditional and modern survey procedures. Modern survey instruments (total stations; laser instruments; GPS systems; etc.). Setting out, construction guiding, and control surveys. Monitoring of movements.

The purpose and tasks of mine surveying. Establishment and measurement of surface and underground control networks. Integration of underground surveys into surface system (connection and orientation measurements, underground height determination). Special instruments in mine surveying (gyroscopic theodolite, laser device, etc. Rock movements, etc. Survey tasks in opencast mines. Underground mine surveying jobs. Special mine survey tasks (breakthrough measurements). Mining maps. Relevant legal regulation. The tasks of a chartered mine surveyor.

Compulsory or recommended literature:

István Havasi - Gábor Bartha: Introduction to GIS: Introduction to Geo-informatics (pp. 10.5) (Gábor Bartha), Satellite Global Positioning Systems (pp. 67) (István Havasi) digital book, http://digitalisegyetem.uni-miskolc.hu, University of Miskolc TÁMOP 4.1.2.-08/1/A-2009-0033 project, 2011.

B. Hoffmann-Wellenhof-H. Lichtenegger, and J. Collins: GPS Theory and Practice Springer Wien New York, 1992, ISBN 3-21183534-2.

István Havasi – István Zergi – Sándor Bíró – Lajos Nagy: Mine Surveying Jobs of a Greenfield Investment (Mining Field Eger III – Limestone) Markscheidewesen, 1/2015 (pp. 23-28), (ISSN: 0174-1357).

Wolfgang Torge: Geodesy (2nd Edition) de Gruyter, Berlin – New York 1991.

Petr Vanicek-Edward Krakiwsky: Geodesy: The concepts, 2nd Edition, Amsterdam-New York-Oxford-Tokyo, 1986.

Ivan I. Mueller-Karl H. Ramsayer: Introduction to Surveying. Frederick Ungar Publishing, USA, 1979. ISBN 0-8044-4666-0

COURSE TITLE: Establishing Mining and Power Generating Systems

Instructor/ Responsible department/institute:

Dr. József Molnár, associate professor
Institution of Mining and Geotechnical Engineering

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Basic parameters of complex systems of raw materials production, preparation and consumption, such as coal mine-preparation plant-power station. General problems of transportation problems. Ton-kilometers of movement of masses of materials in 2D and 3D space and over topographic surfaces or along lines of networks. Determining optimal lines of movement and location of mining facilities minimizing traffic-flow (e.g. payload-distance in ton-kilometers, etc.) or costs. Capital investment and operational costs as functions of basic parameters of the mine, and determining its optimal output. Role of time in optimizing output and location of mining facilities. Logistic problems of the systems of mining (extraction, transportation, storage and distribution). Considering further factors (e.g. geography, mine hazards, risk resulted by technological and economic factors, etc.). Feasibility studies and procedure of opening mines.

Compulsory or recommended literature:

Compulsory literature: Students of the subject receive their compulsory literature or the list of them from the instructor.

Recommended literature:

Birolini, A.: Quality and Reliability of Technical Systems. Theory – Practice – Management. Springer Verlag. Berlin – Heidelberg – New York – London – Paris – Tokyo – Hong Kong – Barcelona – Budapest. 1994. ISBN 3-540-50603-9, ISBN 0-387-50603-9

Gentry, D. W. – O'Neill: Mine Investment Analysis. Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers Inc., New York, New York, 1984.

Hartman, Howard L. (Senior Editor): SME Mining Engineering Handbook I.-II.. 2nd Edition. Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1992.

Hillier, Frederick S. – Lieberman, Gerald J.: Introduction to Operations Research. Holden Day Inc., 1986

Hustrulid, W. A. (editor): Underground Mining Methods. Society of Mining Engineers of the American institute of Mining, Metallurgical and Petroleum Engineers, Inc. New York, New York, 1982.

COURSE TITLE: Mine Haulage Equipment

Instructor/ Responsible department/institute:

Zoltán Virág, PhD, associate professor
Institute of Mining and Geotechnical Engineering

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

The aim of the course is to get to know haulage equipment in mining.

It will provide a comprehensive understanding of the the principles and applications of materials handling and transport systems, and support infrastructure. The course will provide a comprehensive overview of the subject of belt and chain conveying and other hoist engines. It will present the fundamental concepts related to the static and dynamic design of belt conveyor systems. It will provide the understanding necessary for designing and selecting suitable equipment for reliable bulk solids handling and transportation, and for the efficient operation of belt and chain conveyors.

Compulsory or recommended literature:

Hartman (Howard L. (Senior Editor): SME Mining Engineering Handbook I.-II.. 2nd Edition. Society for Mining, Metallurgy and Exploration, Inc. Littleton, Colorado, 1992.

Hustrulid, W. A. (editor): Underground Mining Methods. Society of Mining Engineers of the American institute of Mining, Metallurgical and Petroleum Engineers, Inc. New York, New York, 1982.

Hartman, Howard L. – Mutmansky, Jan M.: Introductory Mining Engineering. 2nd Edition. John Wiley & Sons, 2002. ISBN 9780471348511

William A. Hustrulid, Mark Kuchta, Randall K. Martin: Open Pit Mine Planning and Design, 2006, ISBN 1466575123

Conveyor Equipment Manufacturers Association. Engineering Co.: Belt Conveyors for Bulk Materials, 2014

M. E. Fayed, Thomas S. Skocir: Mechanical Conveyors: Selection and Operation, 1996, ISBN 1566764165

COURSE TITLE: GIS Expert Systems

	Instructor/Responsible department/institute: Prof. Dr. Gábor Bartha, professor emeritus Department of Geodesy and Mine Surveying, Institute of Geophysics and Geo-informatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Terminology in information-theory (communication systems, information measurement, information entropy, signal transmission). Artificial Intelligence (regulating systems, training systems, expert systems). Logical programming (logical program development, PROLOG program language. Types of geo-data. Definition and features of geo-objects. Types of geo-models (vector, raster, and hybrid models). GIS program systems (ArcInfo, Geomedia, and GRASS). The aim and structure of GIS expert program systems. Programming possibilities in various GIS program systems. Logical programming in GIS program systems. Logical programming practices in PROLOG. Basic practices in GIS program systems (ArcInfo, Geomedia, and GRASS). Logical programming in GIS systems (internal programming possibilities of the systems, combination of PROLOG and GIS programs). Realization of simple expert systems.	
	Compulsory or recommended literature: István Havasi - Gábor Bartha: Introduction to GIS digital book: Introduction to Geo-informatics (pp. 10.5) (Gábor Bartha), Satellite Global Positioning Systems (pp. 67) (István Havasi) http://digitalisegyetem.uni-miskolc.hu, University of Miskolc TÁMOP 4.1.2.-08/1/A-2009-0033 project, 2011. Jackson P. Introduction to Expert Systems, 3rd edition, Addison Wesley, ISBN 0-201-87686-8 Stefik M., Morgan Kaufmann, Introduction to Knowledge Systems, ISBN 1-55860-166-X John R. Jensen, Ryan R. Jensen Introductory Geographic Information Systems Jonathan Campbell, MIchael Shin, Essentials of Geographic Information Systems Handbook on geographic information systems and digital mapping, United Nations Publications, 2000	

COURSE TITLE: Machinery of Dewatering and Compressed Air Supply		
	Instructor/ Responsible department/institute: Gábor Ladányi, PhD, associate professor Institute of Mining and Geotechnical Engineering	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Types of pumps. Characteristics of pumps. Characteristic quantities: Delivery head, flow, speed. Positive displacement pumps. The centrifugal pump. Impeller types. Single- and multistagepumps. Pump Curves. Pump suction capability. Task of compressors. Compressor theory. Performance of positive displacement compressor Rating and sizing of reciprocating compressor Capacity control. Heat transfer. Screw compressors. General description of centrifugal compressor. Euler equation of turbomachines. Multistage compressor Operating curve limits: surge and choking Basic regulation theory. Antisurge regulation theory.	
	Compulsory or recommended literature: Karl-Heinz Konka: Schraubenkompressoren (VDI-Verlag Gmbh) Paul C. Hanlon (editor): Compressor Handbook McGRAW-HILL Atlas Copko Handbuch, Drucklufttechnik (Atlas Copko Deutschland Gmbh) M. I. Frenkel: Kolbenverdichter (VEB Verlag Technik Berlin)	

Research topic area: Research in Applied Geophysics

MULTI-DIMENSIONAL HYBRID MODELING OF ELECTROMAGNETIC FIELDS		
	Instructor/ Responsible department/institute: Dr. Endre Turai, associate professor Department of Geophysics, Institute of Geophysics and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: The introduction of hybrid method suitable for electromagnetic fields modeling, which is used with the analytic and approximate solutions, thus enhancing the planning of applications of the electric (VES, HEP) and electromagnetic (MT, VLF, IP, artificial frequency soundings, etc.) for mineral resources and environmental explorations and completion of the multi-dimensional sensitivity analysis. The model types describing geophysical spaces. Summary of the multi-dimensional modeling methods. Modeling method using both analytic and approximate integral solutions techniques. The application of hybrid technique for MT, dipole-dipole soundings, VLF and IP methods. The use of EM modeling methods for carrying out multi-dimensional sensitivity analysis of environmental and raw materials explorations.	
	Compulsory or recommended literature: Kearey P., Brooks M., Hill I., 2002: An introduction to geophysical exploration. Blackwell Publishong Co., Oxford. M. Bath: Spectral Analysis in Geophysics, Elsevier Scientific Publishing Co., 1974. J. V. Candy: Signal Processing, McGraw-Hill Book Company, 1986. Selection from EM modeling professional articles and books chapters published in previous five years.	

CHAPTERS FROM CONTINUUM PHYSICS

Instructor/ Responsible department/institute:

Prof. Dr. Mihály Dobróka DSc, professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

The hierarchy of microscopic and macroscopic description, the role of averaging in the phenomenological approximation. Basics of the non-equilibrium thermodynamics, extensive and intensive quantities, balance equations, conduction equations. The uniform continuum physical discussion of continuum mechanics and electromagnetics. Role of material equations in the continuum physics. Rock mechanical material equations, rheological material models. Wave propagation laws in inhomogeneous, anisotropic dissipative media. Eikonal and WKBJ approximations.

Compulsory or recommended literature:

P. Hertel: Continuum Physics, Graduate Text sin Physics, Springer-Verlag Berlin, 2012

GEOPHYSICAL INVERSION

Instructor/ Responsible department/institute:

Dr. Mihály Dobróka DSc, professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

The geophysical inversion problem, linear and non-linear inverse problem, overview of probability theory. Discrete inverse problem. Gauss inversion, solution of overdetermined and mixed determined inverse problems, underdetermined inverse problem. Application of weight matrix in the data and parameter spaces. Definition of the generalized inverse, resolution according to singular value, covariance matrix, resolution matrix. Robust inversion – solution of inverse problem with the minimization of Lp norm, L1 inversion. Cauchy inversion as weighted least squares method. MFV inversion as weighted least squares method. Joint inversion algorithm and some of their applications: joint inversion of seismic-geoelectric surface and in-mine measurements, inversion of well logging data as joint inversion (interval inversion), joint inversion of well logging and VSP data. General inverse problem. Global optimization methods. Simulated Annealing, Genetic Algorithm. Applications: geophysical tomography, acoustic signal form inversion, Born and Rytov approximations.

Compulsory or recommended literature:

Menke W. Geophysical Data Analysis: Discrete Inverse Theory. Academic Press,London, Sydney, Tokio, Toronto, 1983

Tarantola A.: Inverse Problem Theory. Elsevier Amsterdam, Oxford, New York, Tokio, 1987

GEOINFORMATICS

Instructor/ Responsible department/institute:

Dr. Endre Turai, associate professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Summary of the theoretical bases of information theory. The artificial intelligence research in both software and hardware schools, the synthesis of disciplines, development of informatics. The hierarchy of data, news and information. The general IT and professional informatics. Relation between GIS and geoinformatics, common and different elements. The Geoinformatics as an IT-based synthesis of the land and the natural sciences. The task of Geoinformatics, static and dynamic structure of the geoinformatical systems. Open GIS based software systems. Overview on part systems of Geoinformatics, on essential characteristics and their relationship: the geodetic system, geological sub-systems, geophysical sub-systems, active environmental transformation and environmental management sub-systems, the national economic management and control sub-systems. Data acquisition process and its general characteristics. The process of the data- and information processing and its principal methods. Review of major information sources. The national databases of Geoinformatics.

Compulsory or recommended literature:

Turai, E., Herczeg, Á. 2011: Geoinformatics. Digital university notes. Digitális Egyetem, http://digitalisegyetem.hu/elearning/contents.php?subject_ID=MFGFT6008T-EN

A. Rényi, 1982: Tagebuch über die Informationstheorie, VEB Deutscher Verlag der Wissenschaften, Berlin.

Y. Shirai, J. Tsujii, 1982: Artifical Intelligence, Iwanami Shoten Publishers, Tokyo.

T. Moto-oka, M. Kitsuregawa, 1984: DAI-GO-SEDAI COMPUTER, Iwanami Shoten Publishers, Tokyo.

Selection from geoinformatical and GIS professional articles and books chapters published in previous five years.

MODERN STATISTICAL METHODS

Instructor/ Responsible department/institute:

Norbert Péter Szabó PhD, associate professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Index numbers of relationships of characteristic values. Covariance and correlation matrices and their generalizations. Principal component analysis (PCA) and factor analysis (FA). Cluster analysis (CA). Robust and resistant statistical procedures. The IC function and its role in the quantitative characterization of the sensitivity of statistical procedures to outliers. Norms of prediction errors. The principles of adjustment computations and their tests using Monte Carlo procedures. Simulations in the field of applied geosciences. Characteristic values of uncertainty (accuracy), their relationships and estimation errors. The advantages of using modern error parameters in applied geosciences. Statistical analysis of time series. Some applications of modern statistical methods in applied geosciences and geophysics.

Compulsory or recommended literature:

Isaaks E. H., Srivastava M. R., 1989. An introduction to applied geostatistics. Oxford University Press.

Steiner F., 1997. Optimum methods in statistics. Akadémiai Press. Budapest.

Sharma D. D., 2009. Geostatistics with Applications in Earth Sciences. Springer-Verlag.

Reyment R. A., Jöreskog K. G., 1996. Applied Factor Analysis in the Natural Sciences. Cambridge University Press.

NEW RESULTS OF GEOPHYSICAL INFORMATION TECHNOLOGY

Instructor/ Responsible department/institute:

Dr. Endre Turai, associate professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

The development of geophysical information systems, the current level, the elements of the systems, the inner and external relations, the most important new geophysical data and information processing methods, the geophysical information technology position and role in the national economical information technology, as well as future planned artificial intelligence systems. Short overview of information theory, IT and information systems. The development of geophysical information acquisition and the contacts with artificial intelligence researches. Scientific, economic, strategic and military-industrial influences. The evolution of the computer industry (hardware, software) and the impact to the geophysical information acquisition to the fourth generation. General and specific geophysical systems theory. The overview of general systems theory. Description of geophysical measuring, data,- and information processing systems, system transmissions, system analysis and synthesis. The geophysical information technology and its information systems. The task of geophysical information technology, and the role of geophysical engineering. Characterization of geophysical methods based on the information they provided. The process of geophysical data,- and information acquisition and the basics of planning. The building of geophysical information systems, components and environmental relations. The main geophysical data,- and information processing procedures. The implementation of data-news-information hierarchy in geophysics, production of both quantitative and visual information. The features of geophysical data and information processing procedures (spectral, spatial transformation, statistical, hybrid, visual, model-centric, connected, complex, etc.) and the input-output characteristics. The geophysical sub-systems of Open GIS. Local, regional and international geophysical information networks. The application of artificial intelligence systems for geophysical informatics. Data- and knowledge base relations. Knowledge Base organized (predictive, learning, real-time, etc.) geophysical processing and expert systems. The place of geophysical information technology in knowledge base and in environment-machine interface sub-systems of 5th generation artificially intelligence systems (5GMIR).

Compulsory or recommended literature:

Turai, E., Herczeg, Á. 2011: Geoinformatics. Digital university notes. Digitális Egyetem, http://digitalisegyetem.hu/elearning/contents.php?subject_ID=MFGFT6008T-EN

A. Rényi, 1982: Tagebuch über die Informationstheorie, VEB Deutscher Verlag der Wissenschaften, Berlin.

O. Zhou, B. Lees, G. Tang, 2008: Advences in Digital Terrain Analysis, Springer-Verlag, Berlin.

J. G. Liu, Ph. J. Masson, 2009: Essential image processing and GIS for remote sensing, John

	Wiley & Sons Ltd, Chichester. Y. Shirai, J. Tsujii, 1982: Artifical Intelligence, Iwanami Shoten Publishers, Tokyo. T. Moto-oka, M. Kitsuregawa, 1984: DAI-GO-SEDAI COMPUTER, Iwanami Shoten Publishers, Tokyo. Selection from geoinformatical and GIS professional articles and books chapters published in previous five years.

NEW RESULTS IN GEOTOMOGRAPHY

Instructor/ Responsible department/institute:

Prof. Dr. Mihály Dobróka DSc, professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

The antecedent of geophysical tomography: x-ray and ultrasonic tomographic overview. Methods of seismic tomography. Transformation methods. Series expansion methods. Series expansion according to polynomials (Legendre, Csebisev, etc). Series expansion according to constant cell functions. Seismic tomography as linearized inverse problem. Solution in total state field, generalized inversion, SVD-method, conjugated gradient method. Solution in sub-field, ART and SIRT methods and their variants. Robust tomographic methods, LI method, Cauchy method, tomographic application of the most frequent value method. Seismic absorption tomographic methods, their potentials and limitations, samples for applications. Investigation on accuracy and clarity of tomographic reconstruction. Effect of noises, measuring arrangements, a priori information. Tomographic reconstruction of electromagnetic wave absorption. Tomographic reconstruction of normed data. Adaptation of tomographic methods for approximating inversion of direct current geoelectric measurements – series expansion methods, applications.

Compulsory or recommended literature:

Nolet G.: Seismic Tomography. D.Reidel Publishing Company, Dordrecht, Boston. Lancaster, Tokio, 1987

GLOBAL INVERSION METHODS

	Instructor/ Responsible department/institute: Prof. Dr. Mihály Dobróka DSc, professor Department of Geophysics, Institute of Geophysics and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Overview of direct linear and iterative linear inversion methods. Monte Carlo methods: enumerative and grid-based extrema search techniques, Monte Carlo inversion. Simulated Annealing methods: Metropolis algorithm, Fast Simulated Annealing (FSA), Very Fast Simulated Annealing (VFSA). Genetic Algorithm: classic GA method, Convergent Genetic Algorithm (CGA), Evolution Programming method (EP). Applications, comparison of Simulated Annealing and Genetic Algorithm. Comparison of linear and global inversion methods, advantages of global inversion.	
	Compulsory or recommended literature: Sen M.K. and Stoffa P.L. 1997: Advances in Exploration Geophysics. Vol. 4. Global optimization methods in geophysical inversion. Elsevier Science Ltd. Michalewicz, Z. Genetic Algorithms + Data Structures = Evolution Programs; Springer-Verlag, New York, 1992.	

Interpretation of gravity data sets

	Instructor/ Responsible department/institute: Norbert Péter Szabó PhD, associate professor, Department of Geophysics, Institute of Geophysics and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Regularization constraints in gravity inversion. The analysis of unfiltered and filtered gravity data sets using function w. Concepts of filtering, i.e. depth of penetration, amplification, lateral sensitivity. Joint inversion approaches.	
	Compulsory or recommended literature: Blakely R. J., 1995. Potential theory in gravity and magnetic applications. Cambridge University Press. Cambridge. Steiner F., Zilahi-Sebess L., 1988. Interpretation of filtered gravity maps. Akadémiai Press. Budapest. Jacoby W., Smilde P. L., 2009. Gravity interpretation. Fundamentals and application of gravity inversion and geological interpretation. Springer-Verlag	

New results of well-logging

Instructor/ Responsible department/institute:

Norbert Péter Szabó PhD, associate professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

The determination of petrophysical parameters of shaly sandy hydrocarbon reservoirs, i.e. porosity, water saturation, hydrocarbon saturation, shale volume, permeability, matrix volumes. Up-to-date applications of well logging (lithological, porosity and saturation) methods. Modeling of probe responses. The analysis of sensitivity of measurements. Petrophysical and quality parameters derived from well logs in exploration of mineral stocks (coal, bauxite, and sulphide ores). Hydrogeophysical logging and the interpretation of data. Well-logging interpretation systems used in the international oilfield practice.

Compulsory or recommended literature:

Serra, O., 1984. Fundamentals of well-log interpretation. Elsevier.

Schlumberger, 1991. Log interpretation principles/aplications. Schlumberger Wireline and Testing, USA.

Serra, O., 2007. Well logging and reservoir evaluation. Technip Editions.

SPECIAL DIRECT CURRENT GEOELECTRIC METHODS I.

	Instructor/ Responsible department/institute: Prof. Dr. Ákos Gyulai, DSc, professor emeritus Department of Geophysics, Institute of Geophysics and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Solving geoelectric direct problems in half and total space. Field theoretical investigations, parameter sensitivity, optimal measuring methods. Geoelectric methods in geophysical engineering, application of the method in environmental protection. Inversion of surface measurement data, qualification of inverted parameters. Joint inversion methods in surface exploration.	
	Compulsory or recommended literature: Koefed O (1979) Geosounding Principles, Resistivity Sounding Measurements (276 pages). Amsterdam. Publications from the scope of joint inversion (national and international – in English language min. 5 pieces). The publications connecting to the actual topic are selected by the Instructor. Publications from the scope of geoelectric series expansion inversion – 1,5-D, 2-D, 2,5-D, with automatically weighted inversions (min. 5 pcs). The publications connecting to the actual topic are selected by the Instructor.	

SPECIAL DIRECT CURRENT GEOELECTRIC METHODS II.

	Instructor/ Responsible department/institute: Prof. Dr. Ákos Gyulai, DSc, professor emeritus Department of Geophysics, Institute of Geophysics and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Subsurface geoelectric methods – measurements in mines, tomography between boreholes, combination of surface and subsurface measurements. Inversion of spatial geoelectric measurements, application of joint inversion. Geoelectrical tomography method – selection of measuring geometries, surface and subsurface measurements, tomographyical case studies. Laboratory modelling.	
	Compulsory or recommended literature: Koefed O (1979) Geosounding Principles, Resistivity Sounding Measurements (276 pages). Amsterdam. Survey reports and publications in connection with spatial geoelectric measurements. Minimum 5 pieces selected by the Instructor.	

SPECIAL METHODS IN SEISMIC I.

	Instructor/ Responsible department/institute: Prof. Dr. Mihály Dobróka DSc, professor Department of Geophysics, Institute of Geophysics and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Investigation of wave propagation problems in near surface and deep seismic wave conducting structures. Dispersion equations and displacement functions in homogeneous and laterally inhomogeneous wave conductors (ideal and dissipative media). Dispersion equations in case of varying layer thicknesses. Investigation on detection of geological model characteristics based on parameter sensitivity – detection of inhomogeneities. Role of guided waves in the exploration of geological structures. Methods and problems of generating and receiving guided waves. Methods and applications of dispersion analysis. Inversion of dispersion characteristics (single and joint inversion, tomographical relations).	
	Compulsory or recommended literature: Aki K., Richards P. G.: Quantitative Seismology, University Sceince Books, Sausalito, Canada, 2002	

SPECIAL METHODS IN SEISMIC II.

	Instructor/ Responsible department/institute: Dr. Tamás Ormos, CSc, private professor Department of Geophysics, Institute of Geophysics and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Wave propagation in complex geological structures – physical modelling. Model laws, 2D, 3D models. Measuring technical problems of modelling. Hybrid modelling (numerical + physical). 3D modelling of refracted waves. Development problems of the Common Mid-Point (CMP) refraction method. New ways in refraction method development, 2D-3D CRM method. Solution of inverse problems for 2D and 3D cases. Engineering and environmental geophysical applications. Special subsurface seismic methods, seam wave-seismic, VSP in mines.	
	Compulsory or recommended literature: Aki K., Richards P. G.: Quantitative Seismology, University Sceince Books, Sausalito, Canada, 2002	

NEW RESULTS ON THE DEVELOPMENT OF ELECTROMAGNETIC METHODS I.

Instructor/ Responsible department/institute:

Dr. Endre Turai, associate professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

The new results of rock conductivity. Models for the complex conductivity. The frequency dependence of the complex conductivity relationship with the rock-forming minerals, with the natural and polluted pores content, and with rock texture. The electromagnetic field in polarizable medium. The role of local inhomogeneities and anisotropy in the electromagnetic exploration. 2D and 3D numerical and analogue modeling for electromagnetic fields of different sources. Overview of spatial distortions associated anisotropy and local spatial distortions in certain measuring modifications and field strength components. The role and impact of spatial distortions on the interpretation. Differences in the sensitivity and the information content of each field strength components. The newer modifications of frequency and time domain soundings. EMAP, remote reference-point MT. Methods working in small induction numbers range. Frequency soundings based on the uniform half-space characteristics (CSAM, MELIS, Maxi-Probe, etc.). Newer modifications of transient sounding. Spectral IP method. High frequency methods (radar, various radio frequency techniques). Borehole-surface, Borehole-borehole methods working with combined transmitter-receiver arrangement. The EM methods used for marine exploration. Air electromagnetic methods. Mega-source electromagnetic methods.

Compulsory or recommended literature:

Keller G. W., 1968: Electrical prospecting for oil. Quarterly of the Colorado School of Mines, Colorado.

Keller G. W., Frischknecht F. C., 1966: Electrical methods in geophysical prospecting. Pergamon Press, Oxford.

Sumner J. S., 1976: Principles of induced polarization for geophysical exploration. Elsevier Publishong Co., Amsterdam.

Wait J R. Overvoltage Research and Geophysical Applications. London: Pergamon Press; 1959.

Selection from electromagnetic professional articles and books chapters published in previous five years.

NEW RESULTS ON THE DEVELOPMENT OF ELECTROMAGNETIC METHODS II.

Instructor/ Responsible department/institute:

Dr. Endre Turai, associate professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

New trends in electromagnetic interpretation. The approximate inversion modifications - a complex mirror point, various derivative sectional views, breakdown in to plates, equivalent current systems, etc. – theoretical principles, limits, their role in start-model construction. Comparative evaluation of exact and approximate inversion methods. The electromagnetic imaging. Electromagnetic migration, upward and downward continuation. The position of the electromagnetic methods in modern research strategy. Integrated application of practical geophysics. Earth-physical and deep structure research. Special applications (environmental physics, electromagnetic noises, various monitoring purposes, etc.).

Compulsory or recommended literature:

Kearey P., Brooks M., Hill I., 2002: An introduction to geophysical exploration. Blackwell Publishong Co., Oxford.

Meskó A.: Digital filtering. Akadémiai Kiadó, Budapest, 1984.

P. F. Panter: Modulation, Noise, and Spectral Analysis, McGraw-Hill Book Co, 1965.

M. Bath: Spectral Analysis in Geophysics, Elsevier Scientific Publishing Co., 1974.

J. V. Candy: Signal Processing, McGraw-Hill Book Company, 1986.

Selection from electromagnetic professional articles and books chapters published in previous five years.

NEW RESULTS IN THE DATA AND INFORMATION PROCESSING

Instructor/ Responsible department/institute:

Prof. Dr. Mihály Dobróka DSc, professor
Dr. Endre Turai CSc, associate professor
Department of Geophysics, Institute of Geophysics and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Signal analysis and system analysis in time and frequency domain. The unified negotiations of data processing and geophysical inversion methods. The application of the inversion methods in data processing: determination of Fourier transform and TAU transform using linear and global optimization methods. Image processing methods for data and information processing. Seismic and potential field geophysical applications. The role of neural networks in the fields of data processing and geophysical inversion.

Compulsory or recommended literature:

Menke W. Geophysical Data Analysis: Discrete Inverse Theory. Academic Press,London, Sydney, Tokio, Toronto, 1983

Tarantola A.: Inverse Problem Theory. Elsevier Amsterdam, Oxford, New York, Tokio, 1987

Meskó A.: Digital filtering. Akadémiai Kiadó, Budapest, 1984.

E. O. Brigham: The Fast Fourier Transform, Prentice-Hall Inc.,

R. N. Bracewell: The Fourier Transform and its Applications, McGraw-Hill Book Company, 1978.

+ Selection from the chapters of geophysical data processing books and articles published in the previous 5 years.

Research area: Research on Applied Geology and Hydrogeology

COURSE TITLE: Physical and Structural Geology

Instructor / Responsible institute:

Éva Hartai PhD, associate professor
Institute of Mineralogy and Geology

Norbert Németh PhD, associate professor
Institute of Mineralogy and Geology

Credits: 5

Type of Assessment: examination

Description:

The Earth as a closed system. Earth's cycles. The inner structure of Earth. Magmatic, sedimentary and metamorphic rock-forming processes in the lithosphere. Primary and secondary structural elements of rocks. Rock deformation, brittle and ductile deformation elements. The evolution and main statements of the plate tectonic theory. Types of plate margins. Global geological processes in plate interiors and along plate margins. Causes of plate movements. Plate tectonic evolution of the Earth's large mountain systems.

Compulsory or recommended literature:

Charles (Carlos) Plummer, Diane Carlson & Lisa Hammersley 2012: Pysical Geology. Science Engineering & Maths. ISBN-13: 978-0078096105, ISBN-10: 0078096103

Edward J. Tarbuck and Frederick K. Lutgens & Dennis G. Tasa 2010: Earth: An Introduction to Physical Geology. Prentice Hall. ISBN-13: 978-0321814067, ISBN-10: 0321814061

Haakon Fossen 2012: Structural Geology. Cambridge University Press. ISBN-13: 978-0521516648, ISBN-10: 0521516641

Twiss, R. J. & Moores, E. M 1992: Structural Geology. Freeman & Co., New York, 532 p.

Wolfgang Frisch & Martin Meschede 2010: Plate Tectonics: Continental Drift and Mountain Building. Springer. ISBN-13: 978-3540765035, ISBN-10: 3540765034

COURSE TITLE: Mineralogy		
	Instructor / Responsible institute: Sándor Szakál, DSc, associate professor Institute of Mineralogy and Geology	**Credits:** 5 **Type of Assessment:** examination
	Description: Recognition of the most important minerals, rock-forming, industrial, and environmental aspects. Quartz and felspars – magmatic and metamorphic rocks. Phyllosilicates – chemical weathering, metamorphic, sedimentary processes. Zeolites and ion-exchange capacity. Sulphides, metalls, industrial minerals. Sulphates, weathering of sulphides, acid-rock draining. Oxides-hydroxides, the chemical weathering and industrial minerals. Haloids and evaporites. Carbonates, sedimentary rocks. Borates, and sedimentary rocks. Phosphates and biomineralization. Arsenates and environmental hazards.	
	Compulsory or recommended literature: Wenk, H.R. & Bulakh, A. 2004: Minerals. Their constitution and origin. Cambridge Univ. Press Putnis, A. 1992: Introduction to mineral sciences. Cambridge Univ. Press.	

COURSE TITLE: Geochemistry		
	Instructor / Responsible institute: Sándor Szakál, DSc, associate professor Institute of Mineralogy and Geology	**Credits:** 5 **Type of Assessment:** examination
	Description: The aim of the subject is to make the students be familiar with the followings: the formation of the elements on the Earth and in the Universe; the rules of the distribution of elements; the chemical composition of the Earth, which is determined by complex physico-chemical processes; the isotope geochemistry, which reveals the chemical evolution of the Earth; the geochemistry of water, soil, organic matter, magmatic, sedimentary and metamorphic rocks, by which we can describe the processes of mineral and rock formation in the Earth's crust. Application of geochemistry for researches of raw materials. The geochemistry also help to understand the environmental processes.	
	Compulsory or recommended literature: Wenk, H.R. & Bulakh, A. 2004: Minerals. Their constitution and origin. Cambridge Univ. Press Putnis, A. 1992: Introduction to mineral sciences. Cambridge Univ. Press.	

COURSE TITLE: Hydrogeology

Instructor / Responsible institute:

Prof. Péter Szűcs DSc, professor
Dept. of Hydrogeology and Engineering Geology

Balázs Zákányi PhD, associate professor
Dept. of Hydrogeology and Engineering Geology

Credits: 5

Type of Assessment: examination

Description:

The course of Hydrogeology deals with the new results of the groundwater related topics involving the idea of groundwater as a geologic agent. Classifications of the origins of groundwater, classification according to various criteria, the fundamental physical properties of the aquifer types, water management and water storage characteristics within the framework of the subject. Identification of the relationship between the formation and pore pressures, the groundwater temperature distribution, the geothermal energy and the groundwater quality. The students will be informed about the origin of the water and the possible methods to estimate the age of groundwater. Pumping test methods and the main aspects of well hydraulics are also discussed. After the general knowledge of the hydrogeology the doctoral students deal with the locations and the types of the flow conditions. They will be able to describe the pressure, the temperature and water quality distributions of shallow as well as deep groundwater resources, and the fractured reservoirs. Finally, aspects of the regional flow systems are also delineated.

Compulsory or recommended literature:

R. Allen Freeze, John A. Cherry: Groundwater. Prentice Hall, 1979, ISBN 0-13-365312-9, pp 1-521.

Charles R. Fitts 2002: Groundwater Science. Academic Press, ISBN 978-0-12-257855-7, 450 p.

Neven Kresic, Alex Mikszewski 2013: Hydrogeological Conceptual Site Models. CRC Press, ISBN 978-1-4398-5222-4, 584 p.

COURSE TITLE: Petrology (

Instructor / Responsible institute:

Ferenc Mádai PhD, associate professor
Institute of Mineralogy and Geology

Credits: 5

Type of Assessment: examination

Description:

Aim of the course: for igneous and metamorphic rocks to give an introduction to the principal theoretical questions and to the comprehensive analytical methods and applications. In case of sedimentari rocks, the main focus is on facies analysis based on definition of textural components.

Composition of magma and its properties. Type of magmatic rock bodies, structures, texture types and textural components. Classification methods of magmatic rocks, petrochemical calculations. Magma solidification, thermodynamic models, differentiation and fractional crystallization models. Role of trace elements and isotopes in resloving theoretical questions in petrology. Links between petrogenesis and plate tectonics.

Types of metamorphism, metamorphic texture types and textural components. Formation of metamorphic minerals, phase reactions, stability fields. Texture development in metamorphic rocks, deformation mechanisms, microtectonic analysis. Links between dynamothermal metamorphism and plate textonics.

Weathering mechanisms of rock forming minerals, mineral stability at near-surface conditions. Physico-chemical background of mineral stability at near-surface conditions. Formation of sedimentary structures, principal texture components of sedimentary rocks. Classification of clastic sedimentary rocks based on textural analysis. Classification of carbonate rocks based on textural analysis. Analytical methods applied for clay-rich rocks.

Compulsory or recommended literature:

Compulsory:

Gillespie, M R, and Styles, M T. 1999: BGS Rock Classification Scheme Volume 1, Classification of igneous rocks. British Geological Survey Research Report, (2nd edition) RR 99–06.

Haldar, S. K., and Tisljar J. 2014: Introduction to mineralogy and petrology. (Elsevier, 2014) ISBN 978-0-12-408133-8

Hallsworth, C R, and Knox, R W O'B. 1999: BGS Rock Classification Scheme Volume 3, Classification of sediments and sedimentary rocks. British Geological Survey Research Report, RR 99–03.

Nelson S.A. 2015: Petrology. Open-source textbook, updated in April 2015. http://www.tulane.edu/~sanelson/eens212/

Robertson, S. 1999: BGS Rock Classification Scheme Volume 2 Classification of metamorphic rocks. British Geological Survey Research Report, RR 99–02.

Recommended:

Flügel E. 2010: Microfacies of Carbonate Rocks (Springer, 2010) ISBN 978-3-642-03795-5

	Folk R.L. 1980: Petrology of sedimentary rocks. (Hemphill Publ. co., Austin TX, 1980). ISBN 0-914696-14-9 Gill R. 2010: Igneous rocks and processes. A practical guide. (Wiley-Blackwell, 2010) ISBN 978-1-4443-3065-6 Kornprobst J. 2003.: Metamorphic Rocks and Their Geodynamic Significance (Kluwer, 2003) ISBN 1-4020-0893-7 Passchier, C.W., Trouw R.A.J. 2005: Microtectonics (Springer 2005) ISBN 978-3-540-64003-5

COURSE TITLE: Historical geology

	Instructor / Responsible institute: György Less, DA, full professor Institute of Mineralogy and Geology	**Credits:** 5 **Type of Assessment:** examination
	Description: 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 based on (i) irreversible processes: biostratigraphy, radiometry, and (ii) on reversible processes: magnetostratigraphy, chemostratigraphy, event stratigraphy, sequence stratigraphy. Reconstruction of different (glacial, desert, fluvial, limnic, near-shore, shallow and deep marine) palaeoenvironments and their application in raw material prospecting. Different magmatic, metamorphic and sedimentary facies types. Main fossil groups and their significance in age-determination and in recognition of different paleoenvironments. The geological time scale, structural, climatological and biological evolution of the Earth during the Precambrian, Paleozoic, Mesozoic and Cenozoic. The evolution of Homoidea.	
	Compulsory or recommended literature: 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	

COURSE TITLE: Ore geology

Instructor / Responsible institute:

János Földessy, CSc, professor
Institute of Mineralogy and Geology

Norbert Zajzon, PhD, associate professor
Institute of Mineralogy and Geology

Credits: 5

Type of Assessment: examination

Description:

Description of the formation of different ore deposits and industrial mineral resources, and their mineability and industrial use with special focus on the deposit types and explorations available in Hungary based on the most up to date data and knowledge.

Historical background. Classification of ore deposits. Geological and geotectonical aspects of ore formation. Regeneration theory of ore forming processes. Shape and structure specifications of ore deposits, ore deposit shapes. Geological, geochemical and physico-chemical aspects of ore formation in magmatic environment. Ore formation in hypergene sedimentary environment. Ore formation during metamorphic processes.

Compulsory and recommended literature:

Robb, L. 2010: Ore-forming Processes. Blackwell Publishing, Oxford, 373 p. ISBN: 978-0-632-06378-9

Evans, A.M. 1993: Ore geology and industrial minerals, an introduction. Blackwell Publishing, Malden, Oxford, Carlton. 406 p. ISBN: 978-0-632-02953-2

Laznicka, P. 2010: Giant metallic deposits. Springer Heidelberg Dordrecht London New York. 960 p. ISBN 978-3-642-12404-4

Dill, H.G. 2010: The CHESSBOARD classification scheme of mineral deposits: Mineralogy and geology from aluminum to zirconium. Earth-Science Reviews 100(1-4), Elsevier, Amsterdam, 420 p. ISSN: 0012-8252

COURSE TITLE: Geohydrology, Groundwater resources management

Instructor / Responsible institute:

Balázs Kovács PhD, associate professor
Dept. of Hydrogeology and Engineering Geology

Credits: 5

Type of Assessment: examination

Description:

Elements of hydrologic cycle: Precipitation and its periodic and spatial variability. Groundwater rechrge due to infiltration. Evapotransspitration: aspects of evaporation and transspiration. Mathematical descrription and practical determination of evapotransspiration.

Determination of surface run-of and surface reservation of precipitation originated waters. Determination of groundwater and surface water budget, the interaction of groundwater and surface water resources

Determination of available groundwater and surfacewater resources. Calculation methods of water resource determination. Environmental efects of groundwater production. Quantitative and qualitative protection of groundwater resource. residnce time calculations and susbsurface pathlines. Basic contaminant hydrogeology and contaminant transport. Protection of water resources against contaminantion.

Compulsory or recommended literature:

LaMoreaux et al. Environmental Hydrogeology, IWA Publishing, CRC Press, 2009

Fetter: Applied Hydrogeology, Peareson Education Ltd, 2014

COURSE TITLE: Petroleum geology

Instructor/ Responsible institute:

István Bérczi, CSc, professor emeritus
MOL Institute

Felicitász Velledits, PhD, associate professor
Mineralogical-Geological Institute

Credits: 5

Type of Assessment: examination

Description:

Petroleum geology is one discipline of applied geology, dealing with the origin of oil and gas, their accumulation, exploration and exploitation. Its importance lies in the fact that the world's energy supply at the moment and in the near future is still the largest share of indispensable and hydrocarbon is important chemical raw material as well. Surface and subsurface hydrocarbon occurrences. Oil and gas formation. Subsidence history and modelling. The hydrocarbon migration (migration). The accumulation of hydrocarbons, reservoir types. The fluid content of the reservoir. Geological environment of the hydrocarbon occurrences. The petrophysical properties of the reservoir. The operating mechanism of the reservoir. Methods of hydrocarbon exploration. Reservoir geology. Complex evaluation of research area, research project proposal (IBA competition). Seismic in the petroleum industry. Petroleum rock physics: routines (porosity, permeability, water saturation) and special tests (capillary pressure, relative permeability, pore size distribution measurements), critical input data of the static and dynamic modelling. Initial geological and recoverable assets definition, classification, categorization. Production plants for oil and natural gas reservoirs. Foreign and domestic hydrocarbon occurrences.

Compulsory and recommended literature:

Knut Bjorlykke: Petroleum Geoscience: From Sedimentary Environments to Rock Physics Hardcover – 15 Dec 2010, 2nd edition July 2015. Springer, 622 p. ISBN-13: 978-3642341311

COURSE TITLE: Environmental Geology

Instructor / Responsible institute:

Éva Hartai PhD, associate professor
Institute of Mineralogy and Geology

Viktor Mádai PhD, associate professor
Institute of Mineralogy and Geology

Credits: 5

Type of Assessment: examination

Description:

Geological hazards: volcanism, earthquakes, mass movements, plate tectonic interpretations. Prevention and mitigation of natural disasters by the tools of geology. Geological medium and contamination. Geological factors influencing the extension of contamination. Environmental aspects of mineral extraction. Contamination of soil and water, air pollution. Minerals in the environmental management. Geological aspects of the radioactive waste disposal. Geological storage of carbon-dioxide (CCS). Geological aspects of the environmental assessment. Geological background of the environmental decisions, legal regulation.

Compulsory or recommended literature:

Duncan D. Foley, Garry D. McKenzie & Russell O. Utgard 2008: Investigations in Environmental Geology. Prentice Hall, ISBN-10: 013142064X, ISBN-13: 978-0131420649

Edward A. Keller 2010: Environmental Geology. Prentice Hall. ISBN-13: 978-0321643759, ISBN-10: 0321643755

James S. Reichard 2015: Environmental Geology. McGraw-Hill Education, ISBN-13: 978-0078096075, ISBN-10: 0078096073

Course title: Environmental physico-chemistry		
	Instructor: István Lakatos, Doctor of MTA, Corresponding member of HAS, Professor Emeritus Research Institute of Applied Earth Seciences	**Credits:** 5 **Type of assessment:** examination
	Description: Chemical evolution. The chemistry of the lithosphere. Chemistry of soils, rocks and minerals. The chemistry of the hydrosphere. Water and water based solutions. The chemistry of the atmosphere. Compunds of oxygene and nitrogene, hydrocarbons. Antropogenic pollutants and their chemical alterations.	
	Compulsory and recommended literature: Berecz, E. 1988: Fizikai Kémia. Tankönyvkiadó, 691 p. Atkins, P. W. 1992: Fizikai Kémia I-III kötet. Tankönyvkiadó. Szántó, F 1987: A Kolloidkémia Alapjai. Gondolat Könyvkiadó, 336 p.	

Course title: Coal geology

Instructor / Responsible institute:
Hámorné Vidó Mária PhD Senior Research Fellow

Credits: 5
Type of Assessment: examination

Course description:

The physical, chemical and petrological characterization of the coal. Review of the most important temporal és spatial processes leading to the development of the largest coal deposits, with special attention to the coal exploration, mining and utilization.

Introduction to coal-pettrology: macerals and macreal groups, micro-lithotypes, lythitypes, humus and sapropel coals. The coal formation process. The vegatation as basis of coal formation. Environmental factors influencinf the coal formation. Coal maturation. Physical, chemical and technological propoerties of the coals. Tmporal and spatial relationships of coal formation. The most important coal deposits of the world. Coal deposits of Hungary.

Compulsory and recommended literature:

Diessel F.K:C. 1992: Coal-Bearing depositional systems. Springer-Verlag, Berlin Heidelberg, 721 p.

Hámorné Vidó, M. 2013: 8. Széntelepek. (In: Pál Molnár, E,. Bíró, L. – Eds.) Szilárd ásványi nyersanyagok Magyarországon; GeoLitera könyvek, Szeged, ISBN 978-963-306-244-9; 155-181.

Némedi Varga, Z. (ed.) 1995: A mecseki feketekőszén kutatása és bányaföldtana. – Közlemények a magyarországi ásványi nyersanyagok történetéből VII. Miskolci Egyetem, ISBN 963-661-265 X, ISSN 0231-1917, 472 p.

Némedi Varga, Z. 201: Kőszénföldtan. – A magyarországi kőszén-előfordulások áttekintésével és bibliográfiájával. Miskolci Egyetem Műszaki Földtudományi Kar Ásványtani-Földtani Intézet, Bíbor Kiadó Miskolc, ISBN 978-963-9988-15-6, 245 p.

Suarez-Ruiz, I., Crelling, J.C. 2008: Applied coal petrology;– The role of petrology in coal utilization. Elsevier Publisher, Amsterdam, Boston, heidelberg, London, New York, Oxford, Paris, San Diego, an Francisco, Singapore, Sydney, Tokyo, ISBN: 978-0-08-045051-3, 388 p.

Taylor, H., Teichmüller, M., Davis, A., Diessel, C.F.K., Littke, R., Robert, P., 1998. Organic Petrology. Borntraeger Publisher, Berlin-Stuttgart. 704 p.

COURSE TITLE: Petrophysics

Instructor / Responsible institute:

Ferenc Mádai PhD, associate professor
Institute of Mineralogy and Geology

Credits: 5

Type of Assessment: examination

Description:

Aim of the course: Based on geological-petrographical approach to give an overview on behaviour of rock bodies that are reflected in physical properties and are important in engineering tasks (rheology, stability, weathering conditions, reservoir capacity).

The petrophysical model, properties of different rock components. Types of bounds between rock components. Petrophysical interpretation of texture and texture types. Interrelationship between textural components and anisotropy of the rock texture. Assessing methods of petrophysical condition of rocks. Weathering sensibility of rock components, assessment of weathering conditions, durability of rocks.

Qualification of anthropogenic-derived weathering conditions in the built environment, conservation methods. Mechanical properties of unsaturated rocks. Classification of pore types, permeability. Fracture types and fracture development in rocks. Mechanical properties of fluid-saturated rocks. Interrelationship of important physical properties: wave propagation, electric, thermal conductivity, magnetic properties of rocks with texture. Petrophysical assessment of reservoirs.

Compulsory or recommended literature:

Compulsory:

Arhens T.J. 1995.: Rock physics and phase relations. (AGU 1995) ISBN 0-87590-853-5

Selley R.C. 2000.: Applied sedimentology (Elsevier, 2000)

Guégen Y., Palciauskas V. 1994.: Introduction to the Physics of Rocks (Princeton Univ. Press 1994) ISBN: 9780691034522

Recommended:

Blenkinsop T.2002.: Deformation Microstructures and Mechanisms in Minerals and Rocks (Kluwer, 2002) ISBN 0-412-73480-X

Passchier, C.W., Trouw R.A.J. 2005.: Microtectonics (Springer 2005) ISBN 978-3-540-64003-5

Shaw R.P. (ed.) 2005.:Understanding the micro to macro behaviour of rock-fluid systems Geological Society of Londin Spec. publ. No. 249. ISBN 1-86239-186-6

COURSE TITLE Geology of Hungary

Instructor / Responsible institute:

György Less, DSc, full professor
Institute of Mineralogy and Geology

Felicitász Velledits, PhD, associate professor
Institute of Mineralogy and Geology

Credits: 5

Type of Assessment: examination

Description:

Main objectives of the course:

The aim of the subject is to give knowledge on the geology and the structural development of Hungary in the frame of the Alp-Carpathian region. This includes also the overview of the main stratigraphical units and their rock types by subregions with special emphasis on the occurrences of different raw materials.

Short curriculum of the course:

The main structural units of the Alps, Carpathians and Dinarides, their stratigraphy and metamorphism. The structure and the development of the Pannonian Basin. The recent structure of Hungary and its vicinity, the relationship of recent geographical units with the characteristics of the Earth's crust. Geology of the continuation of Alps in Hungary (the Kőszeg and Sopron Mts., the basement of the Little Plain). Geology of the Hungarian parts of the Western Carpathians (the Aggtelek-Rudabánya Mts., the crystalline basement of the Northern Börzsöny and of the Tokaj Mts.). Geology of the Pelso Block (the Transdanubian Mid-Mountains). Geology of the Hungarian continuation of the Southern Alps and Dinarides (the Mid-Transdanubian zone, the Szendrő-, Uppony- and Bükk Mts.). Geology of the Tisia (the Tisza Unit): the Mecsek Zone including the Szolnok-Maramures flysch Zone, the Villány-Bihor Zone, the Békés-Codru Zone. The Hungarian Paleogene Basin. The Hungarian Neogene and Quaternary.

Compulsory or recommended literature:

Haas, J. (ed.) (2001): Geology of Hungary. 317 p., Eötvös University Press.

Trunkó, L. (1996): Geology of Hungary. 464 p. Gebrüder Borntraeger, Berlin, Stuttgart

Haas J. (ed.) 2013: Geology of Hungary. RegionalGeologyReviews. 244 p., Springer.

COURSE TITLE: Hydrogeology of Hungary

Instructor / Responsible institute:

László Lénárt PhD, associate professor
Institute of Environmental Management

Credits: 3

Type of Assessment: examination

Description:

Scope of subject:

To familiarize students with the hydrogeological structure of Hungary. A detailed overview of being a hydrological basin country. To prepare student how to solve basic hydrology-based design problems.

Brief syllabus:

Water supplies of Hungary, major outlines of water supply management. Regional tectonics parts of Hungary. The hydrological division of Hungary and the basis of division; their comparisons. Water bodies. Utilization and its possibilities, quantity and areas of different water types (shallow ground water, bank-filtered water, deep ground water, water of fissure rocks, karst water. Thermal water reserves in porous and karstic rocks. Mineral and medicinal waters. Matters of regional water production. Water supply protection.

Compulsory or recommended literature:

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

Haas, J. [Editor] (2001): Geology of Hungary, Budapest.

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

Lénárt, L. (2005): Some aspects of the „3E's" (Economics-Environment-Ethics) model for sustainable water usage in the transboundary Slovakian and Aggtelek karst region based on some examples from the Bükk Mountains. PhD thesis work, Kassa/Kosice.

Liebe, P. (2002): Guide Groundwaters in Hungary. VITUKI, Ministry of Envirionment and Water.

Liebe, P. [Editor] (2003): Information on Groundwaters of Hungary, KvVM, CD, Budapest.

Liebe, P. (2006): Guide Groundwaters in Hungary II.. VITUKI, Ministry of Envirionment and Water.

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

Water Framework Directive (WFD 2000) 2000/60/EC of the European Parliament and of the Council of 23 Oct. 2000 establishing a framework for Community action in the field of water policy. Bruxelles.

COURSE TITLE: Geology of industrial minerals

Instructor / Responsible institute:

János Földessy, CSc, professor
Institute of Mineralogy and Geology

Ferenc Kristály, PhD
Institute of Mineralogy and Geology

Credits: 5

Type of Assessment: examination

Description:

The geology, structura and genesis of industrial mineral deposits and building raw materials, with special focus on their exploration, production and potential applications. Industrial minerals related to igneous processes. Sedimentary and metamorphic formations of industrial minerals. Dimension stones, aggregates, cement- their exploration, evaluation, production. processing and application.

Compulsory or recommended literature:

Chatterjee K.K. (2009): Uses of Industrial Minerals, Rocks and Freshwater. ISBN 978-1-60741-400-1 (E-Book). Nova Publishers 575 p.

Evans A.M. (1992): Ore Geology and Industrial Minerals: An Introduction, 3rd Edit5 p. ion. 400 p. Wiley-Blackwell

Némedi Varga Z. (2010): Coal geology - Kőszénföldtan (in Hungarian) - Miskolc, Bíbor Kiadó, 2010, 245p, ISBN 978-963-9988-15-6

Kun B. (szerk) (1989): 25 years history of the National Ore and Mineral Mining Company (in Hungarian). OÉÁ Budapest, http://mek.oszk.hu/09700/09718/

COURSE TITLE: Sedimentology

Instructor / Responsible institute:

Felicitász Velledits PhD, associate professor
Institute of Mineralogy and Geology

Györgyi Juhász PhD
MOL Institute

Credits: 5

Type of Assessment: practical mark

Description:

Sedimentolology is dealing with the sediments, sedimentary rocks and their genetic origine and forming processes. It's importance is justified by the global spread and mass of sedimentary rocks. The energy sources (like coal, oil, and gas) and numerous industrial row material (evaporites, sedimentary and stratiform iron and manganese, bauxites, uranium and rare elements, building materials) and the water also can be found in the sedimentary rocks. Sedimentology is dealing with the origin of the sedimentary grains. Fluid flows and sediment transport. Layering and sedimentary structures. Faciesanalyses. Facies analyses of terrestrial-, sea side, shelf and oceanic environments. Diagenesis means the formation of sediments into sedimentary rocks.

Compulsory or recommended literature:

Nichols G. 2009: Sedimentology and Stratigraphy. 1-432. Wiley-Blackwell.

Tucker M., Wright P. 1991: Carbonate Sedimentology. Blackwell Science.

Wilson J.L. Carbonate Facies in geologic History. Springer

Harold G. Reading 1996, 2006: Sedimentary Environments: Processes, Facies and Stratigraphy, Wiley, London, p.704

Asquith & Gibson: Basic well log analysis for geologists, AAPG, Methods in exploration series

Serra, 1985: Sedimentary environments from wireline logs. Schlumberger p.211

Gerhard Einsele, 2000: Sedimentary Basins: Evolution, Facies, and Sediment Budget, p. 792

Mike R. Leeder, 2011: Sedimentology and Sedimentary Basins: From Turbulence to Tectonics. John Wiley & Sons, p. 784

COURSE TITLE: Contaminated site remediation		
	Instructor: Szabó Imre CSc, Professor emeritus Madarász Tamás PhD, associate professor Institute of Environmental Managent	**Credits:** 5 **Type of Assessment:** examination
	Course description: General questions of contaminated site remediation. Methods and tools of contaminated site investigation, sampling strategies and tools, analytical lab background for site investigation. Latest achievements in stie investigation. Interpretation and visualisation tools of site investigation data, identification of contaminants, pathways and receptors of concern. Conceptudal site model fodmulation. Behaviour of contaminants in soil ang groundwater, soil-contaminant interaction. Methods of contaminant removal, classification and introduction of clean up technoligies (remediation without soil excavation, remediation based on soil excavation, hydraulic barriers, isolation from environment). Selection of appropriate remediation techniques, risk assessment.	
	Compulsory and recommended literature: Barrier Systems for Environmental Contaminant Containment and Treatment, alvin C. Chien, Hilary I. Inyang, Lorne G. Everett, 2005 CRC Press, ISBN 9780849340406 Soil and Water Contamination, 2nd Edition, Marcel van der Perk, November 15, 2013 by CRC Press, ISBN 9780415893435 Remediation Technologies - Tools and resources to assist in contaminated site remediation U.S. EPA Office of Superfund Remediation and Technology Innovation; Online information hub, last updated 2015, http://www.epa.gov/superfund/remedytech/remed.htm#tech	

COURSE TITLE: Seepage hydraulics		
	Instructor / Responsible institute: Balázs Kovács PhD, associate professor Dept. of Hydrogeology and Engineering Geology	**Credits:** 5 **Type of Assessment:** examination
	Description: Groundwater flow equation and its solutions: steady state and transient flow, compressible and incompressible fluids, laminar or turbulent flow, fully or partially penetrating wells. Natural seepage in aquifers. Homogenous and inhomogenous layers. Recharge from precipitation. Unlimited lateral recharge. Interaction of well and drain systems. Groundwater enrichment by surface water infiltration. Operation of vacuum wells. Head losses nearby wells. Monitoring round operating wells. Seepage under embankments or dams.	
	Compulsory or recommended literature: Franciss: Fractured Rock Hydraulics, CRC Press,/Balkema, 2010 Moore: Field Hydrogeology, CRC Press 2012 Fetter: Applied Hydrogeology, Peareson Education Ltd, 2014	

COURSE TITLE: Soil chemistry

Instructor:

Dobos Endre PhD, associate professor
Institute of Geography-Geoinformatics

Credits: 5

Type of Assessment: examination

Course description:

The course focuses on the description of the soil as an environmental factor and its chemical, colloidical properties that responsible for the major processes within the soil environment. It summarizes the major anthropogenic organic and inorganic compounds that can occur in the soil and their potential transportation and transformation, degradation processes. The physical, chemical and biological characteristics of the soils have significant impacts on the way how the anthropogenic compounds reacts. Therefore the understanding on the soil environment and the joint interpretation of the pollutants and the soil environments is crucial for any soil cleaning activity and the assessment of their environmental an anthropogenic risks. The course describes the most common pollutant and soil interactions and the most typical soil systems, where the pollutants arrive and go through several specific transformation processes. The course also covers the topics of soil sampling and sample processing and some basic analytical and pre-processing procedures.

Compulsory and recommended literature:

Bohn, H., McNeal B.L., O'Connor G.A. 2001. Soil chemistry. 3rd Edition. John Wiley & Sons., Inc. New York.

Driessen P.M. and R. Dudal, 1991. The major soils of the World. Lecture notes on their geography, formation, properties and use. Agricultural University of Wageningen. The Netherlands.

USDA-NRCS.1998.Keys to Soils Taxonomy. Eight edition. Washington, USA

IUSS Working group WRB., 2014. World reference base for soil resources 2014. International soil classification system for naming soils and creating legends for soil maps. World soil resource sreport 106. FAO. Rome.

Brady N.C. and R.R. Weil. 2008. The nature and properties of soils.14th edition Prentice Hall, New Jersey, USA

COURSE TITLE: Remote sensing		
	Instructor/ Responsible department/institute: Németh Norbert PhD, associate professor Institute of Mineralogy and Geology	**Credits:** 3 **Type of Assessment:** practical mark
	Description: Terminology. Physical basis: electromagnetic radiation and the atmosphere. Informations gained from EM waves. Photography. Satellites and sensors. Multispectral imagery. Active remote sensing: radar imagery. Photogrammetry and radiometric processing. Application of remote sensing methods in positioning, meteorology, agriculture and biology. Application in geosciences: exploration, environmental geology. Possibilities and criteria of identification of soils, sediments, rock bodies etc. on remote sensing imagery and data. Personal task: geoscientific interpretation of a given dataset (imagery and non-imaging methods)	
	Compulsory or recommended literature: Adams, John: Remote sensing of landscapes with spectral images: a physical modeling approach. Cambridge University Press, Cambridge, 2006. Lillesand T. M. – Kiefer R. W: Remote Sensing and Image Interpretation. Wiley, 1987, 721 p. McCoy, Roger: Field methods in remote sensing. Guilford Press, New York, 2005. Schott, John: Remote sensing: the image chain approach. Oxford University Press, New York, 2007.	

COURSE TITLE: Groundwater flow and contaminant transport modeling

Instructor / Responsible institute:

Viktória Mikita PhD
Dept. of Hydrogeology and Engineering Geology

Balázs Kovács PhD, associate professor
Dept. of Hydrogeology and Engineering Geology

Credits: 5

Type of Assessment: examination

Description:

Theoretical background for GW flow modeling. The GW flow equation in saturated and unsaturated media. Solution scheemes of the flow equation (analitical solutions: Dupuit, Theis-Jacob, Chow, Tóth, etc.; numerical solutions: finite differences, finite elements, analitic elements). Methodology of GW flow modeling: parameters, decisions, errors (conceptual, data or parameter, numerical), modelling techniques. Inverse solution of GW flow equations. Introduction to common GW flow models (MODFLOW (PMWin, Visual modflow, GMS, GW Vistas) and inverse models (UCODE, PEST). Theory of contaminant transport, the transport equation. Solution of transport equation (analitical solutions, numerical and semi-numerical solutions: finite difference, finite elements, method of characteristics, random-walk). Modeling methodology, problems of contaminant transport models. Common contaminant transport models (MT3D, MT3DMS, RT3D, MOC, Random-Walk). Avoiding characteristic numerical errors during solving the transport equation. Use of models in Hydrogeology and Environmental management, and during remediation contaminated sites (problems and solutions in the practice).

Simultaneous use of GW flow and transport models with GIS systems.

Data systems of GW flow and contaminant transport models. Accuracy and relevancy of data, aspects of data set evaluation. Errors and data checking. Model calibration. Groundwater flow and contaminant transport modeling using the Processing MODFLOW for Windows (PMWIN) environment. Case studies and stand-alone modeling task solutions.

Compulsory or recommended literature:

Kresic: Quantitative Solutions in Hydrogeology and Groundwater Modeling, CRC Lewis, 1997

Karamouz – Ahmadi – Akhbari: Groundwater Hydrology: Engineering Planning and Management, CRC Press, 2011

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.

COURSE TITLE: Groundwater prospection and groundwater resources management

Instructor / Responsible institute:

Balázs Kovács PhD, associate professor
Dept. of Hydrogeology and Engineering Geology

Credits: 5

Type of Assessment: examination

Description:

Methodology and principles of groundwater prospecting. Geological, geotechnical, geophysical and remote sensing methods used in prospecting groundwater resources. Basics of GW management. Types and determination of GW resources. Theory of GW protection.

Practical aspects of GW protection, determination of well-head protection areas and planning the hydrogeological protection of GW. Practical work: self-made solutions of simple case-study problems.

Determination of available groundwater and surfacewater resources. Calculation methods of water resource determination. Environmental efects of groundwater production. Quantitative and qualitative protection of groundwater resource. residnce time calculations and susbsurface pathlines. Basic contaminant hydrogeology and contaminant transport. Protection of water resources against contaminantion.

Elements of hydrologic cycle: Precipitation and its periodic and spatial variability. Groundwater rechrge due to infiltration. Evapotransspitration: aspects of evaporation and transspiration. Mathematical descrription and practical determination of evapotransspiration.

Determination of surface run-of and surface reservation of precipitation originated waters. Determination of groundwater and surface water budget, the interaction of groundwater and surface water resources.

Compulsory or recommended literature:

Eds: Findikakis – Sato: Groundwater Management Practices, CRC Press/UNESCO 2011

Chery – de Marsily: Aquifer Systems Management, IAH Selected Papers No. 10, Taylor & Francis, 2007

Nonner: Introduction to Hydrogeology. UNESCO -IHE Lecture Notes, CRC/Balkema, 2010

Boiten: Hydrometry UNESCO -IHE Lecture Notes, CRC/Balkema, 2008

LaMoreaux et al. Environmental Hydrogeology, IWA Publishing, CRC Press, 2009

Fetter: Applied Hydrogeology, Peareson Education Ltd, 2014

Freeze, R.A. – Cherry, J.A. (1979): Groundwater, Prentice-Hall, Englewood Cliffs

N Kresic (1997): Quantitative Solutions in Hydrogeology and Groundwater Modeling. Lewis Publishers.

N Kresic (2007): Hydrogeology and Groundwater Modeling, CRC Press

COURSE TITLE: Water quality protection

Instructor / Responsible institute:

Prof. Péter Szűcs DSc, professor
Dept. of Hydrogeology and Engineering Geology

Balázs Zákányi PhD, associate professor
Dept. of Hydrogeology and Engineering Geology

Credits: 5

Type of Assessment: examination

Description:

The role of water quality protection is getting more and more important due to the dramatic increase in the world population and the more powerful pollution of water resources. Water quality modeling will be in the future one of the most important tool to carry out effective water quality protection plans. Quality issues of groundwater resources should be handled with quality aspects. The growing water needs and the worsening water conditions require remediation plans to improve the quality of groundwater resources. Transport modeling can be the useful tool to describe the the spatial and temporal evolution of the groundwater quality. The main subject topics include: The tasks of water quality protection. The effect of the impurities in the water biosphere. Surface water and groundwater status of the water cycle system. The mechanisms of different contaminants in surface and subsurface waters. The spread of pollutants in the subsurface medium. Water quality modeling. Determination of waste water loadability.

Compulsory or recommended literature:

Liu David, Lipták Béla: Groundwater and Surface Water Pollution. Lewis Publishers, 2000, ISBN 1-56670-511-8, pp. 1-150.

Merkel Broder, Planer-Friedrich Britta: Groundwater Geochemistry. Springer, 2005, ISBN 3-540-24195-7, pp. 1-200.

David M. Nielsen, Gillian L. Nielsen: The Essential Handbook of Ground-Water Sampling. CRC Press, 2006, ISBN 1-4200-4278-5, pp 1-300.

COURSE TITLE: Water works

Instructor / Responsible institute:

László Lénárt PhD, associate professor
Institute of Environmental Management

Credits: 3

Type of Assessment: examination

Description:

Students will be introduced in detail to the planning and design of water works in the water supply course. The subject covers determination of water demands, water supply methods and systems, and the basic facilities of water works. The water works based on subsurface waters are already familiar, and these will get most emphasis. Naturally discussing water works based on surface waters is equally important. In both cases, we will discuss water storing facilities, their tasks, categorization, types, hydraulics and water management sizing, pipelining, equipment, and insulation. Students will practice the tasks of water transport and distribution on a planning level. They will familiarize themselves with the system and the hydraulics sizing of the grid, also the material of the pipe network, pipe joins, pipe profiles, equipment, and all parts of the pipe network. It is very important to discuss also the choice and size of pumps necessary to install in the networks. Students will conduct construction tasks, pressure tests, disinfection and test run measurements as well. In the practice phase of the course, they will prepare the plans all the way to the test run for either an independent small water works or the development of part of an independent water works.

Compulsory or recommended literature:

Breznik, M. (1998): Storage Reservoirs and Deep Wells in Karst Regions. A. A. Balkema /Rotterdam / Brookfield.

Drew, D. – Hötzl, H. (1999): Karst Hydrogeology and Human Activities. A. A. Balkema /Rotterdam / Brookfield.

Eslamian, S. (2014): Handbook of Engineering Hydrology (Three-Volume Set), CRC Press.

Gabolde, G. – Nguyen, J.-P. (1999): Drilling data handbook. Seventh edition. Éditions Technip, Paris.

Hansen, K. – Zenobia, K. (2011): Civil Engineer's Handbook of Professional Practice. ASCE Press.

Liebe, P. (2002): Guide Groundwaters in Hungary. VITUKI, Ministry of Envirionment and Water.

Liebe, P. (2006): Guide Groundwaters in Hungary II.. VITUKI, Ministry of Envirionment and Water.

COURSE TITLE: Water technology		
	Instructor / Responsible institute: Sándor Nagy PhD, associate professor Institute for Raw Material Preparation and Environmental processing	**Credits:** 5 **Type of Assessment:** examination
	Description: The PhD students deal with water technology during a semester. They deal in this topic in detail with mechanical-, and sand filter, settling, clarification, degasification, sterilization, disinfecting and with removal of odour and bad flavour. On the basis of detailed knowledge of water cleaning elements the students design complex drinking water technology lines. As supplement of drinking water treatment they learn about the industrial water processing. Softening of water, desalinizing, plage,- and bathwater treatment are also introduced.	
	Compulsory or recommended literature: M. Henze, P. Harremoes, J. C. Jansen, E. Arvin: Wastewater Treatment. Springer-Verlag Berlin Heidelberg New York, 2002. D. Stephenson: Water and Wastewater Systems Analysis. Elsevier, 1988.	

COURSE TITLE: Advanced analytical methods in materials investigation

Instructor / Responsible institute:

Norbert Zajzon, PhD, associate professor
Institute of Mineralogy and Geology

Credits: 5

Type of Assessment: examination

Description:

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

It gives a detailed introduction about geometrical (shape, texture) information in the micro- and nano size-range, including the comparison of different electromagnetic wave microscopies (optical, SEM, TEM).

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. Point analysis, line-profile measurements and qualitative and quantitative element mapping. Data analysis, chemical formula calculations.

Compulsory or recommended literature:

Reed, S.J.B. 2005: Electron Microprobe Analysis and Scanning Electron Microscopy. Cambridge University Press, Cambridge, 232 p. ISBN: 978-0-521-84875-6

Young, R.A. 2002: The Rietveld Method. Int. Union Crystallogr. Newsl., Oxford University Press, Oxford, New York. 298 p.

Whan, R.E. (vol. coordinator) 1998: ASM Metals Handbook Volume 10 (Materials Characterization). ASM International, printed in the United States of America. 1310 p. ISBN 0-87170-007-7(v.1)

Henderson, G.S., Neuville, D.R., Downs, R.T. (eds.) 2014: Spectroscopic Methods in Mineralogy and Materials Sciences. Reviews in Mineralogy and Geochemistry 78, Min. Soc. Am. USA, 800 p. ISBN: 978-0-939950-93-5

Bish, D.L., Post, J.E. (eds.) 1989: Modern Powder Diffraction. Reviews in Mineralogy and Geochemistry 20, Min. Soc. Am. USA, 369 p. ISBN: 978-0-939950-24-9

COURSE TITLE: Karst hydrogeology

Instructor / Responsible institute:

László Lénárt PhD, associate professor
Institute of Environmental Management

Credits: 3

Type of Assessment: examination

Description:

Scope and objective of subject:

To familiarize students with the process of karstification under different morphological and geological conditions. Defining karst water and categorizing karst water types. To determine the origin of karst water, and to analyze its movements through the different sized lithoclasis systems. To complete detailed analysis of utilization of karst water and the problems of utilization from an environmental point of view. To prepare student how to solve simple basic karst-hydrological problems.

Thematic description of subject:

Definition and process of karstification. Definition, origin and types of karst water. The movement of karst water, area infiltration, sinkholes. Tracing the movements of the water, water tracing. Aggregation in the karst, their utilization, protection. Objects of karst water of hydraulic structures, karst water production. Dewatering and water return in deposit. Karst water monitoring systems. Vulnerability of karstic areas, water quality problems. Protection zones and areas. Environmental questions of karst water utilization. Ecological and public water supplies and demands. Substituting karst waters with other waters, its consequences.

Compulsory or recommended literature:

Biondic, B. – Bakalowicz, M. (1995): Hydrogeological aspects of groundwater protection in karstic area. European Comission, COST action 65. Final report, EUR 16547 EN, Brussel.

Bonacci, O. (1987): Karst Hydrology. Springer-Verlag, Berlin / Heidelberg / New York / London / Paris / Tokyo.

Breznik, M. (1998): Storage Reservoirs and Deep Wells in Karst Regions. A. A. Balkema /Rotterdam / Brookfield.

Brooks., K.N. –Efolliott, P.F. – Gregersen, H.M. – Thames, J.L. (1996): Hydrology and the management of Watersheds, Iowa State University.

Drew, D. – Hötzl, H. (1999): Karst Hydrogeology and Human Activities. A. A. Balkema /Rotterdam / Brookfield.

Dreybrodt, W. (1988): Process in Karst Systems. Springer-Verlag, Berlin / Heidelberg / New York / London / Paris / Tokyo.

Kullman, E. (1990): Karst-fissure waters, Bratislava.

Lénárt, L. (2005): Some aspects of the „3E's" (Economics-Environment-Ethics) model for sustainable water usage in the transboundary Slovakian and Aggtelek karst region based on some examples from the Bükk Mountains. PhD thesis work, Kassa/Kosice.

	Liebe, P. (2002): Guide Groundwaters in Hungary. VITUKI, Ministry of Envirionment and Water. **Liebe, P. (2006):** Guide Groundwaters in Hungary II.. VITUKI, Ministry of Envirionment and Water. **Singhal, B.B.S. – Gupta, R.P. (2010):** Applied Hydrogeology of Factured Rocks, Springer.

COURSE TITLE: Hydrogeology of geothermal systems		
	Instructor / Responsible institute: Prof. Péter Szűcs DSc, professor Dept. of Hydrogeology and Engineering Geology Balázs Kovács PhD, associate professor Dept. of Hydrogeology and Engineering Geology	**Credits:** 5 **Type of Assessment:** examination
	Description: Students study the production and utilization technologies of geothermal energy, based on the applied fluid mechanics and heat transfer. They can get the ability to elaborate geothermal projects, feasibility studies. They will became to organize and lead implementations of different geothermal energy production and utilization systems. The short curriculum of the subject: Origin and nature of geothermal energy. Geothermal systems. Main types of geothermal reservoirs. Fluid mechanics and heat transfer in production and injection wells, and bore-hole heat exchangers. Subsurface and surface production equipments: submersible pumps, heat exchangers, heat pumps, HDR, EGS technologies. Rankine, ORC and Kaline cycles. Electricity production and direct uses. Lindal diagram. Environmental impacts.	
	Compulsory or recommended literature: Lund J.: Geothermal Power Plants, Geo Heat Center, Oregon, USA, 2004. Lund J.: Direct Heat Utilization of Geothermal Energy, Geo Heat Center, Oregon, USA, 2002. Rybach L.-Muffler L.J.R.: Geothermal Systems, John Willey New York, Brisbane, Toronto, 1981. Toth A.-Bobok E.: Limits of sustainable heat extraction from dry holes. Stanford University, 2008. Glassley: Geothermal Energy: Renewable Energy and the Environment, CRC Press, 2010 Chandrasekharam - Bunschuh: Low Enthalpy Geopthermal resources for Power Generation, CRC/Balkema, 2008 Stauffer et al.: Thermal Use of shallow groundwater, CRC Press, 2014	

Research area: Physical and Human Geography

COURSE TITLE: Subdivision and classification of the landscapes and geomorphologic regions of Carpathians and Carpathian Basin		
	Instructor/Responsible department/institute: Prof. Dr. Attila Hevesi, professor emeritus Institute of Geography and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Even today, there is no clear scientific consensus of classification and subdivision of the landscapes and geomorphologic regions of Charpatian Basin in Hungarian geography. The course covers both the traditional, modern and alternative classifications. In the course these classification methods are examined and evaluated considering several aspects of classification and assessment of landscape.	
	Compulsory or recommended literature: Kocsis K. and Schweitzer F. (eds.) (2009) Hungary in maps. Geographical Research Institute, Hungarian Academy of Sciences, Budapest, 211 p. Lóczy D. (2015): Geomorphological Regions. In: Lóczy D. (ed.) Landscapes and Landforms of Hungary. Springer, pp. 39–43. Pécsi M. (1970) Geomorphological regions of Hungary. Akadémiai Kiadó, Budapest, 45 p. New, enlarged edition: (1996) Geographical Research Institute, Hungarian Academy of Sciences, Budapest, 121 p. Pécsi M. (1977) Geomorphological map of the Carpathian-Balkan Mountain system, 1:1,000,000. Studia Geomorphologica Carpatho-Balcanica 11:3–11 + colour map Pécsi M. and Somogyi S. (1969) Subdivision and classification of the physiographic landscapes and geomorphological regions of Hungary. In: Sárfalvi B (ed.) Research problems in Hungarian applied geography. Akadémiai Kiadó, Budapest, pp. 7–27.	

COURSE TITLE: Ethnic-, Religious- and Political Geography

Instructor/ Responsible department/institute:

Prof. Dr. Károly Kocsis, director
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

Since the birth of modern nations many attempts have been made in Europe to homogenize the new nation-states (e.g. assimilation, forced migrations). Nevertheless, the society of the Carpatho-Pannonian Area (EC and SE Europe) remained during the last century one of the ethically, religiously and culturally most diverse societies in our continent.

The course building on the knowledge learned on the undergraduate and master studies, highlights the complex geographic background of the ethnic, religious and political conflicts in the Carpatho-Balkanic Area and Eastern Europe, with special regards to the Hungarian minorities in the Carpathian Basin, the Serbian-Croatian-Bosnian, the Serbian-Albanian, the Albanian-Macedonian, Bulgarian-Turkish conflict, the situation of the Roma diaspora in SE Europe and the Ukrainian-Russian conflict, war in Ukraine.

The study of the effect of the ethnic-religious structure on the political (electoral) behaviour of the population, on the administrative division, and the presentation of the authonomy aspirations of the minorities are also integral parts of this topics.

Compulsory or recommended literature:

Karácsonyi D. – Kocsis K. – Kovály K. – Molnár J. – Póti L.: East–West dichotomy and political confl ict in Ukraine – Was Huntington right? Hungarian Geographical Bulletin 63: (2) (2014) 99-134.

Kocsis K.: Changing religious structure of the population and the secularization in the Carpatho-Pannonian area during the 20th century. ACTA UNIVERSITATIS CAROLINAE GEOGRAPHICA 44:(1-2) pp. 83-102. (2009)

Kocsis K.: Historical predecessors and current geographical possibilities of ethnic based territorial autonomies in the Carpathian Basin. Hungarian Geographical Bulletin 62: (1) (2013) 3-46.

Kocsis K. - Tátrai P. (eds.) Changing Ethnic Patterns of the Carpatho-Pannonian Area. Institute of Geography, Hungarian Academy of Sciences, Budapest, 2012 (1st ed.), 2013 (2nd ed.) http://www.mtafki.hu/konyvtar/karpat-pannon/

Short J. R. An introduction to political geography. Routledge, London, 1993 (2nd ed.)

Stump R. W. The Geography of Religion: Faith, Place, and Space. Rowman and Littlefield, Lanham, 2008.

Taylor P. J. - Flint C. Political geography: world-economy, nation-state and locality. Pearson Education Lim, Harlow, 2007.

COURSE TITLE: History of Geography

Instructor/Responsible department/institute:

Prof. Dr. Hevesi Attila, professor emmeritus
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

The course investigates the ways how the subject of geography has been recognized, perceived, and evaluated, from its early acknowledgment in ancient Greece to its disciplined form in today's world of shared ideas and mass communication. The course covers the analysis of changes of the position of geography in the systems of sciences and in everyday life. The course also focuses on less known „geographers" from Carpathian region, whose work is worthy of recognition.

Compulsory or recommended literature:

Driver, F. (1992) Geography's empire: histories of geographical knowledge, Environment and Planning D: Society and Space, Vol. 10, pp. 23–40.

Harley, J. B. and Woodward, D. (eds.) (1987) The History of Cartography, Volume 1, Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean. Chicago, University of Chicago Press. 622 p.

Harley, J. B. and Woodward, D. (eds.) (1992) The History of Cartography, Volume 2, Book 1. Cartography in the Traditional Islamic and South Asian Societies. Chicago, University of Chicago Press. 604 p.

Harley, J. B. and Woodward, D. (eds.) (1994) The History of Cartography, Volume 2, Book 2. Cartography in the Traditional East and Southeast Asian Societies. Chicago, University of Chicago Press. 998 p.

Holt-Jensen, A. 1999: Geography. History and Concepts – SAGE Publications, London – Thousand Oaks – New Delhi. 248 p.

Martin, G. J. (2005) All Possible Worlds: A History of Geographical Ideas. Fourth Edition. Oxford Univeristy Press. 624 p.

Stoddart, D. R. (1986) On Geography and its History. Oxford: Blackwell. 335 p.

Woodward, D. and Lewis, G.M. (eds.) (1992) The History of Cartography, Volume 2, Book 3. Cartography in the Traditional African, American, Artic, Australian, and Pacific Societies. Chicago, University of Chicago Press. 500 p.

Woodward, D. (ed.) (2007): The History of Cartography, Volume 3. Cartography in the European Renaissance, Part 1. Chicago, University of Chicago Press. 2272 p. (http://www.press.uchicago.edu/books/HOC/HOC_V3_Pt1/Volume3_Part1.html) (http://www.press.uchicago.edu/books/HOC/HOC_V3_Pt2/Volume3_Part2.html)

COURSE TITLE: Adminisrative Geography (The Relation Between Geographical Factors and Administration)

	Instructor/ Responsible department/institute: Dr. Tibor Elekes, associate professor Institute of Geography and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: The role of the geographical features in the formation of the adminstrative units, the signaficance of the historical, social. economic and political factors in the change of spatial organization structure. The modification and revaluation of these factors related to historical periods, can be traced in the social, economic processes. Summing up the adminstrative changes of a historic area we need to investigate source-books and prepare several time- crosssection cartographic synthesis of administrative units.	
	Compulsory or recommended literature: Hajdú Z. 2009. Characteristics of historical evolution. In: Kocsis K, Schweitzer F (eds.): Hungary in maps. Geographical Research Institute Hungarian Academy of Sciences, Budapest, pp. 21-28. Hajdú Z. 1990. State building processes after 1990. In: Horváth Gy, Hajdú Z (eds.) Regional Transformation Processes in the Western Balkan Countries. Pécs: Hungarian Academy of Sciences Centre for Regional Studies, Pécs, pp. 44-72. Elekes T. 2007. Aspects of settlement system and environment relation in Gheorgheni region, Romania, in the last seven centuries. In: STUDIA Universitatis Babeş-Bolyai - AMBIENTUM, I/1, Cluj-Napoca, pp.87-94. Elekes T.-Gyenizse P. 2007. Landscape and settlement system relation in the region of Odorhei from 14th Century till nowdays. In: Environment&Progress 9/2007, Mediul-Cercetare, Protecţie şi Gestiune 2006, Cluj-Napoca, pp.181-186. Elekes T. 2011. Relation between settlement system and natural environment in Ciuc-basin in the last seven centuries. In: Ecoterra. Year VIII, nr. 26, University Babeş-Bolyai from Cluj-Napoca – S.C. I.C.P.E.Bistrita, pp. 55-60. Hajdú Z. 2013. Transformation of the Hungarian views concerning the Danube region in the period around the end of World War II and the start of the rearrangement, 1944-1948. In: PROBLEMINA GEOGRAFIJATA (1-2) pp. 74-88.	

COURSE TITLE: GIS Applications for Physical- and Social Geographic Research and Visualization

Instructor/ Responsible department/institute:

Beáta Siskáné Szilasi PhD, associate professor
Institute of Geography and Geoinformatics

János Vágó PhD, assistant professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

In physical- and social geographic research, the GIS (Geographic Information System) based methods are useful tools for the visualization of the results. The application of these methods basically means the creation and interpretation of thematic maps. The main advantage of the GIS-based method is that visualizing the geographic data, those conclusions can be also drawn, which could not been available by the „conventional" analyzing methods.

The course covers the modern, state of the art GIS-based analyzing methods: the possibilities and tools of ESRI ArcMAP and GS MapWiever for spatial data analysis, visualization and interpretation:

-
uantitative and qualitative thematic mapping methods of spatial data representing surface units (polygon)

-
uantitative and qualitative thematic mapping methods of spatial data representing discrete objects (point, polyline)

-
nterpolation of discrete spatial data, properties of interpolation methods

-
nalysis, visualization and interpretation of 3D raster surfaces made by interpolation.

Compulsory or recommended literature:

Allen, David W. (2011): GIS Tutorial 2: Spatial Analysis Workbook. ESRI Press.

Jakobi Á. Nemes-Nagy J. (2006): Digital surfaces in social geography. Studia cartologica 13, 185-192.

MacEachren, A.M. and Taylor, D.R.F. (2013): Visualization in Modern Cartography. Elsevier.

Slocum, Terry A. (2009): Thematic Cartography and Geovisualization. Pearson Prentice Hall.

Wilson, Michael J. (2014): Learning ArcGIS 10. 2 Basics. CreateSpace Independent Publishing Platform.

COURSE TITLE: Soil genetics and classification

Instructor/ Responsible department/institute:

Prof. Dr. Erika Micheli Csákiné, professor
University

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

The course builds on basic soil science knowledge and provides information on soil genesis and classification. It describes the soil forming processes and factors and the diagnostic properties, horizons that can develop in the soil, and their physical, chemical and morphological properties.

The course summarizes the major characteristics and approaches of the traditional and the modern soil classification systems. Having described the internationally used classification systems a thorough comparative description of the Hungarian soil classification system and the correlation of its classes and units will be made. The soil classes will be attributed with their ecological functions and geographic distribution as well.

Compulsory or recommended literature:

Micheli E, Dobos E., B. Houskova, N. Filippi, L. Montanarella, R.J.A. Jones. 2004. European Summer school on soil survey. EUR 21196 EN. European Commission, Italy

Driessen P.M. and R. Dudal, 1991. The major soils of the World. Lecture notes on their geography, formation, properties and use. Agricultural University of Wageningen. The Netherlands.

USDA-NRCS.1998.Keys to Soils Taxonomy. Eight edition. Washington, USA

IUSS Working group WRB., 2014. World reference base for soil resources 2014. International soil classification system for naming soils and creating legends for soil maps. World soil resource report 106. FAO. Rome.

COURSE TITLE Regional Human Geography

Instructor/ Responsible department/institute:

Beáta Szilasi Siskáné PhD, associate professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

In this course the following main topics' global characteristics and problems will be analyzed.

1.
patial analysis of natural and human cultures Cities, as the repository of problems

2.
rea studies Regional stresses

3.
uman-landscape interactions Tourism and economic relations and problems

The spatial analyzes include many of the concepts and processes that are related to geographic information science and systems (GIS): analysis of the interactions and effects on each other, we use a variety of computer data bases in the processing of information related to global problems.

The examinations of trends happen in the Earth through the large regions which are changing the current global economic and social features. (The Earth's population problems and spatial trends; Migration and mobility; A modern multi-polar world economy; Transport and infrastructure).

Compulsory or recommended literature:

Kreag, G. 2001: The Impacts of Tourism. Minnesota Sea Grant. Publication Number: T 13. 20 p. http://www.seagrant.umn.edu/tourism/pdfs/ImpactsTourism.pdf

World Regional Geography; Saylor URL: http://www.saylor.org/books 1073 p

World Trade Organization, 2010: GLOBAL PROBLEMS, GLOBAL SOLUTIONS: Towards Better Global Governance. 228 p.
https://www.wto.org/english/res_e/booksp_e/public_forum09_e.pdf

COURSE TITLE: Physical Geography of the Continents

Instructor/ Responsible department/institute:

János Vágó PhD, assistant professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

The aim of the course is the overall analysis of those geologic, geomorphologic, climatic, hydrogeographic and biogeographic factors which have impact on the physical geography of the continents. The course also covers the examination of the spatial relationship between these factors. The learning material also focuses on the introduction of physical geography of the continents, and on the interaction between the natural environment and the human society.

The detailed physical geographic introduction of the continents covers the of Europe, Asia, Australia and Oceania, Africa, North- and South America:

- he location of the continents and its natural borders
- he evolution of the continents: Precambian, Paleozoic, Mesozoic and Cenozoic landscape development, particularly the effects of glacations, periglacial processes
- nalysis of the evolution and occurrence of typical landforms
- valuation of the climatic attributes of the continents and the climate determinant factors (relief, ocean currents, etc.)
- ydrographic-hydrogeographic characterization of the continents. The characteristics of rivers and lakes (area and shape of the catchments, discharge, types of lakes)
- ntroduction of the biogeographic characteristics and soils of the continents, geographical zonation
- lobal natural hazards (including the anthropogenic factors) and the examination of their spatial occurrence.

	Compulsory or recommended literature: Anderson, R. S., Anderson, S. P. (2010): Geomorphology. The Mechanics and Chemistry of Landscapes. Cambridge University Press. Marsh, W. M., Kaufman M. M. (2012): Physical Geography. Great Systems and Global Environments. Cambridge University Press. Muller, P.O., Williams, R.S., De Blij, H.J. (2003): Physical Geography: The Global Environment. Oxford University Press.

COURSE TITLE: Soil Geography of the World

Instructor/ Responsible department/institute:

Dr. Endre Dobos, associate professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

The course starts with the definition of the soil functions in the different regions of the World and the related soil and climate conditions. The course uses the commonly accepted WRB classification system to describe and classify the soils. All significant physical and chemical soil properties will be described under the soil units. All regions are characterized with their dominant and associated soil types. Having known the soil conditions the significant land uses will be listed and the major restrictions and risks due to the land management are described as well.

Compulsory or recommended literature:

Driessen P.M. and R. Dudal, 1991. The major soils of the World. Lecture notes on their geography, formation, properties and use. Agricultural University of Wageningen. The Netherlands.

IUSS Working group WRB., 2014. World reference base for soil resources 2014. International soil classification system for naming soils and creating legends for soil maps. World soil resource report 106. FAO. Rome

Micheli E, Dobos E., B. Houskova, N. Filippi, L. Montanarella, R.J.A. Jones. 2004. European Summer school on soil survey. EUR 21196 EN. European Commission, Italy

USDA-NRCS.1998.Keys to Soils Taxonomy. Eight edition. Washington, USA

COURSE TITLE Forms of Social Mobility and Migration and Their Relationship with Tourism Geography

Instructor/ Responsible department/institute:

Beáta Szilasi Siskáné PhD, associate professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

In this course the following main themes and models related to the mobility and migration forms are discussed:

1.
ocial mobility (Characteristics and forms of the vertical and horizontal mobility, inter-and intragenerational mobility)

2.
igration (commuting, international migration, balance of migration, newest trends of the migration process in Europe and Hungary)

3.
ethods of analysis (ISA paradigm, Stratification Paradigms, road modell of sociology, longlinear paradigm, Internal and international migration, data sources and ratios)

4.
ourism and migration (spatiality, displacement, movements, motivations and infrastructure)

The social mobility has far-researching effects for the type and functioning of society.

The inequality of the chance of social mobility is a type of the human inequalities.

It is a contentious issue that the trends of social mobility are influenced by the economic, social and political system, or primarily the social mobility depends on the social structure and its changes.

Man is migratory creature. The transformation of processes related to the subject area is intensive, so the new analyses of domestic and international migration is necessary.

Two basic factors determine the movement of tourists: the place and the time.

Several researcher carries out the movement of tourists and the new forms of mobility at national and international level. During their research they examine not only the mobility form of tourists and their migration but the sustainability and social factors which influence these processes.

In the context of this subject the latest migration trends and their spatial characteristics are examined.

Compulsory or recommended literature:

Williams, M.A.—Hall, M.C. 2002: Tourism, migration, circulation and mobility. in: Williams, M.A.—Hall, M.C. (eds.) Tourism and Migration. Netherlands, pp. 1-52

Scuttari, A. - Della Lucia, M. – Martini, U. 2012: Integrated Planning of Sustainable Tourism and Mobility: An Exploratory Study. in: Tiller, T.R. (ed.): Mobilities and Sustainable Tourism. Conference Proceedings of BEST Education Network, Breoux les Bains, pp. 161-181

Zai Liang 2006: The sociology of migration. In: –LOCALITY AND SOCIAL LIFE, pp. 487-495

Department for International Development: Moving out of poverty –making migration work better for poor people. DFID UK, 2007. 53 p.

COURSE TITLE Current Issues and Methodology of Urban Geography

	Instructor/ Responsible department/institute: Beáta Szilasi Siskáné PhD, associate professor Institute of Geography and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination

Description:

The urbanisation is the process of growing of the population density, which means two things: the increasing of the number of cities and the number of city dwellers.
The cities, as the place of the growing of the population density, during the social development have to be confronted many of the problems, for example: natural, physiological, social-geographical and economical conflicts. In the case of the cities it is important to be able to maintain the balance between the built and natural environment.

- crowded spaces, constructions problems
- degradable parts of the city, slum problems
- the ratio of the green areas
- Using and developing of the public spaces,
- problems of the touristically preferred districts, events, accommodations and restaurants
- urban peripheral, brown field, former (abounded) industrial areas,
- crime processes and the treatment (Placing and density of the surveillance cameras)
- waste management
- shopping centres, transport
- cultural identity and heritage
- public transport, parking systems
- the spatial distribution of the administration
- municipal development plans and vision
- agglomeration of the city and availability

The research methodology section provides an overview of possible options and their methods of analysis, publication and presentation through an analysis of the problems.
The international research results are analyzed through English and German literature examples.

Compulsory or recommended literature:

V Blotevogel „Stadtgeographie“ SS 01 Kap. 1 Entwicklung und Aufgabenfelder der Stadtgeographie, Grundbegriffe 'Stadt' und 'Urbanisierung' http://www.ruhr-uni-bochum.de/imperia/md/content/zda/infopool/blotevogel_stadtgeographie_kapitel1.pdf
Fabian Bross 2009: Skript: Wirtschafts- und Stadtgeographie. LudwigMaximilians-Universität München. 17 p
Urban geographies I: Still thinking cities relationally. Progress in Human Geography June 2012 36: 412-422, first published on October 24, 2011
From urban political economy to cultural political economy: rethinking culture and economy in and beyond the urban. Progress in Human Geography August 2009 33: 447-465, first published on February 24, 2009

COURSE TITLE: Digital Soil Mapping

Instructor/ Responsible department/institute:

Dr. Endre Dobos, associate professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
Examination

Description:

The traditional soil mapping procedure is based on the analysis of the relationship between the soil properties and the soil forming factors. The mapping procedure consists of the model development describing these relationships, and the spatial delineation of the homogeneous soil units. The fast technological development of the past few decades have made available the use of soil related digital data sources, like digital terrain models and satellite data. The relationships between the soil properties and these digital data sources can be described with mathematical, statistical-geostatistical tools, therefore automated soil mapping procedures have become available.

The course describes the traditional soil mapping approaches and procedures and their digital soil mapping analogies. It summarizes the potential digital datasets and data sources and the mapping tools and algorithms most commonly used in digital soil mapping and the potential fields of applications.

Compulsory or recommended literature:

Dobos, E., Carre F., Hengl T, Reuter H and Tóth G. 2006. Digital soil mapping – as a support for production of functional maps. EUR 22123 ENOffice for the Official Publications of the European Commission. Luxemburg.

Hengl T, Reuter H. (eds) 2009. Geomorphometry. Concepts, Software, Applications. Developments in Soil Science. Vol. 33. Elsevier. Amsterdam

Lagacherie P., McBratney A., Voltz M. 2007. Digital soil mapping. An introductory perspective. Developments in Soil Science. Vol. 31. Elsevier. Amsterdam

USDA-NRCS.1998.Keys to Soils Taxonomy. Eight edition. Washington, USA

IUSS Working group WRB., 2014. World reference base for soil resources 2014. International soil classification system for naming soils and creating legends for soil maps. World soil resource sreport 106. FAO. Rome.

Driessen P.M. and R. Dudal, 1991. The major soils of the World. Lecture notes on their geography, formation, properties and use. Agricultural University of Wageningen. The Netherlands.

COURSE TITLE Snow and Avalanche Science and Modelling

Instructor/ Responsible department/institute:

Dr. Anna Seres, PhD, honorary associate professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

Description of snow forming in the atmosphere and its modification on the ground: The connection between different types of snow crystals and different atmospheric conditions. Properties of the snow cover: temperature gradient, wetness, layering. Metamorphism f snow crystals in the snowpack: initial changes, equitemperature metamorphism, temperature gradient metamorphism, melt-freeze metamorphism, formation of bonds between grains, formation of weak layers, metamorphism along hard layers.

Avalanche characteristics, formation of avalanches: Classification of avalanches. Formation of different types of avalanches with respect to terrain, snowpack and weather. Forces in the snowpack.

Modification of some important meteorological parameters (temperature, wind, precipitation, radiation, etc.) in alpine area.

Avalanche modelling: Basics of model building. Spatial modelling of the changes of meteorological parameters and the processes in the snowpack with GIS. Modelling of avalanche risk based on terrain, weather and snowpack.

Active and passive protection against avalanches: snow profiles, stability tests, route selection, necessary equipment, rescue, land use plans, use of explosives, defensive structures.

Compulsory or recommended literature:

McClung, D., Schaerer, P. 1999. The Avalanche Handbook, Seattle, Washington, The Mountaineers

Goodison, B.E., Ferguson, H.L., McKay, G.A. 1981. Measurement and data analysis in Handbook of Snow: Principles, Processes, Management and Use, (Grey, D.M., Male, D.H. eds.), The Blackburn Press, Cadwell, New Jersey, USA, ISBN: 1-932846-06-9

https://www.whiterisk.ch/en/

http://www.meted.ucar.edu/afwa/avalanche/

COURSE TITLE: Karst Geomorphology

Instructor/Responsible department/institute:

Prof. Dr. Hevesi Attila, professor emmeritus
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

Karst is a geological formation that is created due to dissolution of soluble bedrocks, primarily limestone, dolomite and marble, but also gypsum and halite. In this course the unique karst landform features: its morphometric attributions, its formation and development and its distribution on Earth's surface (and under the surface) are investigated. The course also covers the review of hazards of karst terrain due to human activities.

Compulsory or recommended literature:

Encyclopedia Speleologica Practicorum
http://www.speleoencyclopedia.com/encyklopedia_start_eng.php

Ford, D. and P. Williams (2007) Karst Hydrogeology and Geomorphology. John Wiley and Sons Ltd., the West Sussex, England, 562 p.

Gunn, J. (ed.) (2004) Encyclopedia of cave and karst science. Routledge, 960 p.

Hevesi A. (1989) Development and evolution of karst regions in Hungary. Karszt és Barlang Különszáma pp. 3-16. + 2 tables.

Jakucs L. (1977) Morphogenetics of Karst Regions: Variants of Karst Evolution. Akadémiai Kiadó, Budapest, 284 p.

Jakucs L., Keveiné Bárány I. and Mezősi G. (1983) A modern interpretation of karst corrosion = A karsztkorrózó korszerű értelmezése. Földrajzi Közlemények Vol. 107. (31.) No. 3–4., pp. 207–212, 213–217.

Veress M. (2010) Factors influencing solution in karren and on covered karst. Földrajzi Értesítő Vol. 59. No. 3. pp. 289–306.

COURSE TITLE: Soil description and analysis procedures		
	Instructor/Responsible department/institute: Prof. Dr. Erika Michéli Csákiné, professor Szent István University	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: The course summarizes the field soil profile description and analysis procedures, their field and lab tools and equipments. It covers the topics of site description, soil sampling, processing and storage requirements, its national and international standards and routines, and the state of the art, detailed soil description methodologies, like proximal sensing and data interpretation.	
	Compulsory or recommended literature: USDA-NRCS. 2014. Soil Survey Investigations Report No. 42, Version 5.0. USDA. Washington. USA. USDA-NRCS.1998.Keys to Soils Taxonomy. Eight edition. Washington, USA IUSS Working group WRB., 2014. World reference base for soil resources 2014. International soil classification system for naming soils and creating legends for soil maps. World soil resource report 106. FAO. Rome. FAO, 2006. Guidelines for soil description. Rome Schoeneberger, P.J., D.A. Wysocki, E.C. Benham, and Soil Survey Staff. 2012. Field book for describing and sampling soils, Version 3.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, Nebraska, USA	

COURSE TITLE: Soil Chemistry

Instructor/ Responsible department/institute:

Dr. Endre Dobos, associate professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

The course focuses on the description of the soil as an environmental factor and its chemical, colloidical properties that responsible for the major processes within the soil environment. It summarizes the major anthropogenic organic and inorganic compounds that can occur in the soil and their potential transportation and transformation, degradation processes. The physical, chemical and biological characteristics of the soils have significant impacts on the way how the anthropogenic compounds reacts. Therefore the understanding on the soil environment and the joint interpretation of the pollutants and the soil environments is crucial for any soil cleaning activity and the assessment of their environmental an anthropogenic risks. The course describes the most common pollutant and soil interactions and the most typical soil systems, where the pollutants arrive and go through several specific transformation processes. The course also covers the topics of soil sampling and sample processing and some basic analytical and pre-processing procedures.

Compulsory or recommended literature:

Bohn, H., McNeal B.L., O'Connor G.A. 2001. Soil chemistry. 3rd Edition. John Wiley & Sons., Inc. New York.

Driessen P.M. and R. Dudal, 1991. The major soils of the World. Lecture notes on their geography, formation, properties and use. Agricultural University of Wageningen. The Netherlands.

USDA-NRCS.1998.Keys to Soils Taxonomy. Eight edition. Washington, USA

IUSS Working group WRB., 2014. World reference base for soil resources 2014. International soil classification system for naming soils and creating legends for soil maps. World soil resource sreport 106. FAO. Rome.

Brady N.C. and R.R. Weil. 2008. The nature and properties of soils.14th edition Prentice Hall, New Jersey, USA

COURSE TITLE: Landscape Evaluation (Geographical Landscape Evaluation)

Instructor/ Responsible department/institute:

Dr. Tibor Elekes, associate professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other):
examination

Description:

Within the framework of the former subjects (geology, soil science, water geography, meteorology, geomorphology, biogeography ,etc.)the system-based investigations of the already known landscape elements. Understanding the interrelationships between the components of the landscape elements, their spatial arrangement, their chronological change and analysis of their quantative and qualitative characteristics. Exploration and delination of specific ecotypes, their complex geographic characterization, assessment and typifying. Possibilities and applications of the geographical evaluations from natural and social aspects.

Compulsory or recommended literature:

Elekes T.- Gyenizse P.- Nagyváradi L. 2008. Relation between forests and settlements in the catchment area of the river Feernic. In: STUDIA Universitatis Babeş-Bolyai - AMBIENTUM, 1-2, Cluj-Napoca. pp. 81-87.

Elekes T.- Gyenizse P. 2010. Landscape and settlement system relation in the region of the Aries river from the 12th century till nowdays. In: Ecoterra, an VII, nr. 24, Universitatea Babeş-Bolyai – I.C.P.E.Bistrita. pp. 6-7.

Elekes T.- Lénárt L. 2007. Some aspects of the relation between settlement system and natural environment in Covasna county. In: Environment&Progress 11/2007, Mediul-Cercetare, Protecţie şi Gestiune 2006, Cluj-Napoca (Romania). pp. 154-159.

Gyenizse P.- Nagyváradi L.- Elekes T. 2009. Settlement expanding and environment survey by geoinformatical methods. In: Ecoterra, an VI, nr.20, Universitatea Babeş-Bolyai – I.C.P.E.Bistrita. pp.20-21

Lóczy D, Dingsdale A. 2001. The environmental challenge of societal transition in East Central Europe In: Turnock D (edit.) East Central Europe and the former Soviet Union : environment and society, London: Edward Arnold, 2001. pp. 187-199.

Lóczy D, Sipőcz M. 2008. Evaluating the physico-geographical background to game management: example of red deer in Southern Transdanubia. In: Hanusz Á. (edit.) Tiszteletkötet Dr. Göőz Lajos professzor 80. születésnapjára. Nyíregyháza: Nyíregyházi Főiskola Turizmus és Földrajztudományi Intézet, pp. 147-154.

COURSE TITLE Empirical Research Methodology of Social Geography		
	Instructor/ Responsible department/institute: Beáta Szilasi Siskáné PhD, associate professor Institute of Geography and Geoinformatics	**Credits:** 5 **Type of Assessment (examination/ practical mark / other):** examination
	Description: Within the framework of the subject will be study the necessary knowledge of research preparation and the different empirical methods and basic criteria of data processing. During the semester we will study the stages of the intervention areas: Finding Problem: clarify the characteristics of the problem and / or consider why a problem is a problem. - iagnosis (problem determination/definition); - mplementation compare interventions, which may solve the problem; - onitoring (testing) to describe the changes; - valuation: establish the impact of the implementation We will examine how to make special research topics, questions, how can be displayed a research proposal, what types of research strategies exist. The quantitative research strategies and their characteristics will have a key role. We also deal with the following topics: - alidity in the research strategy - ampling, Interview types and Data Analysis - Comparison of qualitative and quantitative research, - resentation of the results of the research in reports - During the processing the students have to learn how to use the SPSS statistical software.	

	Compulsory or recommended literature: Babbie, E.R. 2011: The practice of social research. Wadsworth, Cengage Learning Belmont USA. 33 p. Fieldsa, T.D., Thomas Z.Lysb, Linda Vincent 2001: Empirical research on accounting choice. Journal of Accounting and Economics 31 (2001) pp. 255–307. Landau S.-B. S. Everitt 2004: A Handbook of Statistical Analyses using SPSS. CHAPMAN & HALL/CRC, 339 p.

COURSE TITLE: Drainage Basin- and Drainage Network Morphometry

Instructor/ Responsible department/institute:

János Vágó PhD, assistant professor
Institute of Geography and Geoinformatics

Credits: 5

Type of Assessment (examination/ practical mark / other): examination

Description:

The aim of the course is the introduction to the analysis of drainage basin morphometry, to the major morphometric parameters and to the methods and possibilities of GIS based- and statistical analysis. The course also covers the valley- and stream network analysis, the calculation of those parameters which have an impact on the development of drainage network, the possible fields of application of drainage morphometry.

The main topics of the course are the following:

- nvironmental/natural factors of the drainage network- and watershed evolution
- nalysis of the morphometric characteristics of watersheds (location, shape, etc.)
- rainage hierarchy, stream order and magnitude
- nalysis of drainage pattern
- nalysis and interpretation of stream profile graphs, application of numerical methods for the calculation of stream gradient
- Interpolating and interpretation of stream gradient maps
- lassification of valleys according to their aspect
- alculation of valley- stream- and outfall density
- nalysis of stream directions.

Compulsory or recommended literature:

Hack, J.T. (1973): Stream-profile analysis and stream gradient index. Journ. Res. U.S. Geol. Survey, Vol.1. No 4. July-Aug. pp. 421-429.

Horton, R. E. (1945): Erosional development of streams and their drainage basins. Hidrophysical approach to quantitative morphology. Bulletin of Geological Society of America 56. pp. 275-370.

Leopold, L.B., M. Gordon Wolman, and John P. Miller (1995): Fluvial Processes in Geomorphology. Reprinted. Dover Publ.

Robert, A. (2003): River Processes: An Introduction to Fluvial Dynamics. Hodder Arnold, London.

Swades, P. (2014): Drainage Basin Morphometric Methods and Analysis. Lambert Academic Publishing.

Zavoianu, I. (1985): Morphometry of Drainage Basins (Developments in Water Science), Elsevier Science Ltd; 2nd Revised edition.

Research area: Fluid Production and Transport Systems

COURSE TITLE: Petrophysics

	MFAKK406B **Instructor:**	**Credits: 5** **Pre-requisites: -**
	Course description: The aim of this subject to introduce the petrophysical behavior of oil, gas and water bearing layers that influence the storage and production capacity of reservoir rocks. Subject covers the laboratory determination methods of basic (porosity, permeability, saturation) and special (relative permeability, capillary pressure, specific surface area, tourtoozity, i.e.) petrophysical properties that are important from the point of view of hydrocarbon and water production. The subject also covers the correlation methods that are necessary to determine these properties without laboratory measurement. The subject summarizes the parameters that influence the petrophysical properties and the relationships between the petrophysical properties. Knowing the petrophysical properties of reservoir rock the original oil and gas in place can be determined.	
	Compulsory or recommended literature resources: ▪ József Pápay: Development of Petroleum Reservoirs, Akadémiai Kiadó, Budapest, 2003. ISBN 963 05 7927 8 ▪ ONARPOUR, M., KOEDERITZ, L., HERBERT HARVEY, A.: Relative permeability of petroleum reservoirs. CRC Press, Inc., 0-8493-5739-X, 1986.TÓTH J., BÓDI T., SZŰCS P., CIVAN F.: Direct Determination of Relative Permeability from Nonsteady-State Constant Pressure and Rate Displacements. SPE 67318, SPE Production and Operations Symposium, Oklahoma City, Oklahoma, 2001. március 24-27. ▪ INTÉR Á., BÓDI T.: Comparison of capillary pressure and relative permeability curve determination methods (Usporedba metoda za odredivanje krivulja kapilarnog tlaka i relativnih propusnoti). Nafta i Plin, INA, Strucni Casopis, Hrvatske Udruge Naftnih Inzenjera i Geologa, Vol. 33., Nr. 137/2013., ISSN 1330-2434 ▪ INTÉR Á., BÓDI T.: Determination of Capillary Pressure and Relative Permeability Curves with a Novel Ultra Rock Centrifuge. Geosciences and Engineering, A Publication of the University of Miskolc, Vol. 1, Nr. 1 (2012), HU ISSN 2063-6997	

COURSE TITLE: Reservoir Fluids

	MFAKK407B **Instructor:** **Research Institute of Applied Earth Sciences**	**Credits: 5** **Pre-requisites: -**
	Course description: The aim of this subject to analyse the properties of the oil, gas and water reservoir fluids that are important from the point of view of oil, gas and water production. The subject covers the theoretical and practical questions of phase behaviours of the fluids. Summarize the correlation procedures that can be used to calculate the temperature and pressure dependent properties of oil, gas, and reservoir water (formation volume factor, density, viscosity,	

	dissolved gas ratio, i.e.). The candidates get acquainted with the theoretical basics of PVT measurement get acquainted with practical application with equations of state (EOS) in the petroleum industry generally.
	Compulsory or recommended literature resources: ▪ József Pápay: Development of Petroleum Reservoirs, Akadémiai Kiadó, Budapest, 2003. ISBN 963 05 7927 8 ▪ . János Török, Lipót Fürcht, Tibor Bódi: PVT Properties of Reservoir Fluids. University of Miskolc Miskolc, Hungary 2012. ISBN 978-963-661-988-5 p. 1-192 ▪ urtis H Whitson and Michael R. Brule: Phase Behavior. SPE Monograoh Volume 20. Richardon, Texas, 2000.

COURSE TITLE: The Material Balance Equations and Their Application		
	MFAKK412B **Instructor:** **Anita Jobbik Ph.D., research fellow** **Research Institute of Applied Earth Sciences**	**Credits: 5** **Pre-requisites: -**
	Course description: The aim of the subject that the students learn the material balance equations of oil and gas reservoirs (saturated-, undersaturated oil, gas- and gascondensate reservoirs) based on the law of the conservation of mass. The subject covers the finite and finite-differential forms of material balance equations, and the practical methods by which one can calculate the original oil and gas in place, the reserves, the water influx properties, and driving indices, and can perform the production forecast at different condition.	
	Compulsory or recommended literature resources: ▪ József Pápay: Development of Petroleum Reservoirs, Akadémiai Kiadó, Budapest 2003. ISBN 963 05 7927 8 ▪ rian F. Towler: Fundamental Pinciples of Reservoir Engineering, SPE Textbook Series Vol. 8. Richardson, Texas, 2002. ▪ . 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 TITLE: Improved Oil and Gas Recovery Methods		
	MFAKK413B **Instructor:** **Research Institute of Applied Earth Sciences**	**Credits: 5** **Pre-requisites: -**
	Course description: The aim of this subject to introduce the complex (IOR and IGR) methods that are capable to produce a further major share of the resources that can not be produced by natural energy. The candidates get knowledge about physical-chemistry, filtration, mass- and thermal	

	transport processes and reservoirmechanical theoretical basics of complex methods. The candidates acquire the development design, the controlling, and the practical application of this complex (IOR, or IGR) production methods.
	Compulsory or recommended literature resources: ▪ . Ahmed: Reservoir Engineering Handbook, Gulf Publishing Co., 2001, ISBN 0-88415-770-9 ▪ . P. Dake: Fundamentals of Reservoir Engineering, Elsevier, 1978, ISBN 0-444-41830-X ▪ József Pápay: Development of Petroleum Reservoirs, Akadémiai Kiadó, Budapest 2003. ISBN 963 05 7927 8 ▪ József Pápay: Explotation of Unconventional Petroleum Accumulation, Akadémiai Kiadó, Budapest 2013. ISBN 978 963 05 9464 6

COURSE TITLE: Well Tests

	MFB443 **Instructor:** **Research Institute of Applied Earth Sciences**	**Credits: 5** **Pre-requisites: -**
	Course description: The aim of this subject that the candidates obtain knowledge about pertrophysical properties of reservoir rocks, respectively the production capacity and quantitative characterization of the well completion of vertical and horizontal wells that were drilled to open the reservoir. The candidates obtain comprehensive knowledge about the hydrodynamical well tests that can be performed for oil, gas and water reservoirs. The hydrodynamical well tests cover the methods based on pressure change measurement in wellbore including the single and multiple pressure measurement. The candidates recognize the in-situ capacity measurement procedures of the wells, and get acquainted with practical application of the fundamental evaluation methods.	
	Compulsory or recommended literature resources: ▪ oland N. Horne: Modern Well Test Analysis a Computer-Aided Approach. Petroway, Inc. California, USA 1995. ISBN 0-9626992-1-7 ▪ . Bódi: Well Testing: Inflow Performance and Deliverability of Oil and Gas Wells. University of Miskolc, 2007. ▪ ichael Golan, Curtis H. Whitson: Well Performance. P T R Prentice Hall Inc. Englewood Cliffs, New Jersey 1991 ▪ guilera R. Artindale J.S. Cordell G.M. Ng M.C. Nicholl G.W. Runions G.A., Horizontal Wells, Formation Evaluation, Drilling and Production. Gulf Publishing Company Houston USA, 1991.	

COURSE TITLE: Underground Gas Storage

	MFAKK425B **Instructor:** **László Tihanyi, Professor Emeritus** **Institute of Petroleum and Natural Gas**	**Credits: 5** **Pre-requisites: -**
	Course description: The aim of this subject that the candidates become acquired the methods and procedures by which one can design a desired capacity underground gas storage in depleted gas reservoirs or in water bearing layers (aquifers). The subject covers the operation, controlling methods that are necessary for the safety operation of the yearly cyclic processes taken place in underground gas storage.	
	Compulsory or recommended literature resources: ▪ József Pápay: Development of Petroleum Reservoirs, Akadémiai Kiadó, Budapest 2003. ISBN 963 05 7927 8 ▪ . Rasin Tek: Natural Gas Underground Storage: Inventory and Deliverability. PennWell Publishing. Co. 1996. ▪ atural Gas Market Review 2007 - Security in a globalising market to 2015, OECD/IEA, Paris, 2007, p.289. ▪ lanigan, O. (1995): Underground Gas Storage Facilities, Gulf Publishing Co., Houston	

COURSE TITLE: Fluid Dynamics		
	MFKGT401B **Instructor:** **Elemér Bobok, Professor Emeritus** **Anikó Nóra Tóth, Associate Professor** **Institute of Petroleum and Natural Gas**	**Credits: 5** **Pre-requisites: -**
	Course description: Elements of kinematics, Balance equations: conservation of mass, momentum equation. balance of angular momentum, balance of kinetic energy, conservation of energy, balance of entropy. The perfect fluid: Euler's equation, Bernoulli equation, Kelvin's vortex theorem, elements of gasdynamics. Laminar flow: Navier-Stokes equation, dynamical similarity, Poiseuille flow. Elementary boundary layer theory. Turbulent flow: Reynolds equation, Kármán's similarity criterion, mixing length, turbulent flow in pipes, energy equation, head losses in pipes and fittings.	
	Compulsory or recommended literature resources: ▪ obok Elemér: Fluid Dynamics; Gazdász-Elasztik Kft. Miskolc, 2012. ISBN 978-963-358-009-7 ▪ obok E.: Fluid Mechanics for Petroleum Engineers. Elsevier, Amsterdam, New York, Tokyo 1993. ▪	

treeter W. et. al: Fluid Mechanics, Auckland: McGraw-Hill, 1983.

COURSE TITLE: Gas Dynamics

MFKGT402B
Instructor:
Elemér Bobok, Professor Emeritus

Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Courses description:
Balance equations, Vázsonnyi-Crocco equation. Small perturbations. Dynamical similarity. Critical flow. Isentropic flow in nozzles. High velocity gas flow with friction. Shock waves, weak and strong discontinuities. Discontinuous balance equations at a shock surface. Jump in flow variables across singular surfaces, normal and oblique shock waves.

Compulsory or recommended literature resources:

- obok Elemér: Fluid Dynamics; Gazdász-Elasztik Kft. Miskolc, 2012. ISBN 978-963-358-009-7
- obok E.: Fluid Mechanics for Petroleum Engineers. Elsevier, Amsterdam, New York, Tokyo 1993.
- treeter W. et. al: Fluid Mechanics, Auckland: McGraw-Hill, 1983.

COURSE TITLE: Heat Transfer

MFKGT403B
Instructor:
Elemér Bobok, Professor Emeritus
Anikó Nóra Tóth, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
First law of thermodynamics. Internal energy balance equation. Differential equation of thermal conductivity. Analytic solutions: stationer, transient, plates, pipe walls. Two dimensional models with complex variable functions. Numerical solutions. Heat transfer between the fluid and the wall. Similarity of heat transfer processes. Convection, conduction and heat transfer in the pipelines, and the wells.

Compulsory or recommended literature resources:

- arlslaw, H.S., Jaeger, J.C.(1959): Conduction of Heat in Solids, Oxford University Press
- anhn D.W., Necati Ozisik M. (2012): Heat Conduction, Wiley, New Jersey
- ngersoll, L.R.(2008): Heat Conduction with Engineering and Geological Applications,
- iji Latif, M.(2009): Heat Conduction, Springer, Berlin, Heidelberg
- ybach, L. Muffler L.J.P.(1981): Geothermal Systems, Wiley, New York

COURSE TITLE: Gas Pipeline Systems

	MFKGT426B **Instructor:** **László Tihanyi, Professor Emeritus** **Institute of Petroleum and Natural Gas**	**Credits: 5** **Pre-requisites: -**
	Course description: Trends in energy supply in Europe. Role of natural gas in energy supply. Trends in natural gas transport systems and trends in Europe. Natural gas transmission. General flow equation. Calculation methods of gas properties. Effects of pressure and temperature for gas flow. Steady-state and transient flow in gas pipeline system. The role of line-pack. Codes and standards for pipeline design. Pipeline wall-thickness calculation and material grade selection. Thermodynamics of polytrophic gas compressors. Compressor station. Economics of long-distance gas transmission systems. Pipeline construction and commissioning. Drying methods. Gas regulation stations. Gas blending stations. Transient flow in gas pipeline systems. Operation strategies for gas pipeline systems. Gas flow measurement and allocation rules for a complex gas supply system. Pipeline pigging.	
	Compulsory or recommended literature resources: ▪ ohitpour M.–Golsham H.–Murray A.: Pipeline Design and Construction ASME Press, pp. 654, 2000, ISBN 0-7918-0156-X ▪ ohitpour M.–Szabo J.–Hardeveld T.: Pipeline Operation and Maintenance ASME Press, pp. 653, 2005, ISBN 0-7918-0232-9 ▪ ohitpour M.–Murray A.–Mcmanus M.–Colquhoun I.: Pipeline Integrity Assurance ASME Press, pp. 582, 2010, ISBN 978-0-7918-5956-8 ▪ ohitpour M.–Botros K.–Hardeveld T.: Pipeline Pumping and Compression Systems ASME Press, pp. 582, 2008, ISBN 978-0-7918-0278-6	

COURSE TITLE: Pipeline Integrity

	MFKGT427B **Instructor:** **László Tihanyi, Professor Emeritus** **Institute of Petroleum and Natural Gas**	**Credits: 5** **Pre-requisites: -**
	Course description: Pipeline integrity and safety. Trends in pipeline integrity inspection and rehabilitation. Pipeline risk assessment and safety. Pipeline corrosion and cathode protection. Different methods of pipeline route patrolling. High consequence area identifications. Pipeline integrity management (PIM) programs. In-line inspection tools. Tool accuracy. Location accuracy. Tool data validation methods. Defect sizing. Defect assessment methods. Pipeline repairs codes. Repair method selection. Repair procedures.	
	Compulsory or recommended literature resources: ▪	

ohitpour M. – Golsham H. – Murray A.: Pipeline Design and Construction ASME Press, pp. 654, 2000, ISBN 0-7918-0156-X
▪
ohitpour M. – Szabo J. – Hardeveld T.: Pipeline Operation and Maintenance ASME Press, pp. 653, 2005, ISBN 0-7918-0232-9
▪
ohitpour M. – Murray A. – Mcmanus M. – Colquhoun I.: Pipeline Integrity Assurance ASME Press, pp. 582, 2010, ISBN 978-0-7918-5956-8

COURSE TITLE: Natural Gas Distribution

MFKGT428B
Instructor:
Istvan Szunyog, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
Natural gas distribution systems: parts of the system, types of distributed gases, gas quality questions connecting with distribution and utilization. The structure and characters of gas industry, technical-safety-legal systems. Gas pressure regulation; pressure regulation stations. Planning and constructing natural gas distribution pipelines. Simulation and development of pipeline systems. Operating of distribution systems. Capacity management, nomination, allocation. Safety questions of gas distribution systems.

Compulsory or recommended literature resources:

▪
P gas safety: guidelines for good safety practice in the LP gas industry. UNEP, Paris, 1998. ISBN 92-807-1711-1
▪
.V. Nederlandse Gasunie: Physical properties of natural gases, 1988. pp. 33-212.
▪
asr, G.G. – Connor, N.E.: Natural Gas Engineering and Safety Challenges; Springer, 2014, ISBN 978-3-319-08947-8
▪
eebles, M.: Natural Gas Fundamentals. Shell International Gas Ltd., 1992.

COURSE TITLE: Natural Gas Utilization Systems

MFKGT429B
Instructor:
István Szunyog, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
Physical-chemical properties of natural gases. Domestic gas appliances: types, characterisation, firing- and thermal measurements. Gas burners: construction, classification, working, designing and dimensioning. Flue gas systems: classification, designing and

	dimensioning. Emission and imission. Natural gas utilization systems inside building site: structure, parts, designing. Calculation of building's heat demand. Special side of natural gas industry: production, transmission, storage and utilization of liquefied natural gas; planning, constructing and operating of propane-butane gas systems. Safety engineering of propane-butane supply**.**
	Compulsory or recommended literature resources: ▪ .R.N. Jones: Domestic gas burner design; British Gas, Spon, London and New York, 1989. ISBN 0 419 14800 0 ▪ azlehurst, John: Tolley's Basic Science and Practice of Gas Service; Vol1, Routledge, 2009, ISBN9781856176712 ▪ azlehurst, John: Tolley's Domestic Gas Installation Practice; Vol2, Routledge, 2012, ISBN9781856176835 ▪ azlehurst, John: Tolley's Industrial and Commercial Gas Installation Practice; Vol3, Routledge, 2009, ISBN 9781856176729 ▪ . Warnatz, U. Maas, R.W. Dibble: Combustion; Springer-Verlag, New York, 2006. ISBN 9 783 54025 992 3 ▪ ackner, Maximilian; Palotás, Árpád; Winter, Franz: Combustion; Wiley-VCH, ISBN9783527333516 ▪ .V. Nederlandse Gasunie: Physical properties of natural gases, 1988. pp. 33-212.

COURSE TITLE: Special Natural Gas Utilization Systems		
	MFKGT430B **Instructor:** **István Szunyog, Associate Professor** **Institute of Petroleum and Natural Gas**	**Credits: 5** **Pre-requisites: -**
	Course description: Gas metering and settling: physical metering principles, accuracy of metering, PTZ corrections. Gas supply of industrial and commercial consumers: boiler rooms, boiler plants, in-plant systems. Combined heat and power systems: gas engines, gas turbines, fuel cells, special firing equipments. Natural gas and propane-butane gases as engine fuel. Interchangeability of natural gases and other flammable gases: prescriptions, end user effects, peak shaving. Theory of gas explosions: basics, gas accumulation, gas explosion in closed spaces, blasts.	
	Compulsory or recommended literature resources: ▪ azlehurst, John: Tolley's Basic Science and Practice of Gas Service; Vol1, Routledge, 2009, ISBN9781856176712 ▪ azlehurst, John: Tolley's Domestic Gas Installation Practice; Vol2, Routledge, 2012, ISBN9781856176835	

- azlehurst, John: Tolley's Industrial and Commercial Gas Installation Practice; Vol3, Routledge, 2009, ISBN 9781856176729
- . Warnatz, U. Maas, R.W. Dibble: Combustion; Springer-Verlag, New York, 2006. ISBN 9 783 54025 992 3
- ackner, Maximilian; Palotás, Árpád; Winter, Franz: Combustion; Wiley-VCH, ISBN9783527333516
- .J. Harris: Gas explosions in buildings and heating plant; British Gas, Spon, London and New York, 1989, ISBN 0 419 13220 1

COURSE TITLE: Renewable Energy

MFKGT431B
Instructor:
Anikó Nóra Tóth, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
Conditions for utilization of renewable energies. Low and medium-high enthalpy geothermal power generation systems. Closed loop geothermal systems. Kalina-type systems. Carnot cycle. Heat pumps. Vacuum tube solar collectors. Solar chimneys. Organic fuel cells. Wind turbines. The environmental aspects of the utilization of renewables. Ongoing national and international projects, case studies**.**

Compulsory or recommended literature resources:

- eothermics, Perggamon Press, ISSN: 0375-6505, 1992
- enewable Energy in Europe, ISBN:978-1-84407-875-2, 2010

COURSE TITLE: Biogas Treating and Utilization

MFKGT432B
Instructor:
István Szunyog, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
Typical compositions and chemical characteristics of natural gases and biogases. Phase behaviour of hydrocarbons and other gases. Thermal characters. Condensation point. Formation of hydrates. Cleaning of biogas: physical and chemical adsorption, membrane separation, molecular filters, condensing, and other cleaning technologies. Separation of carbon dioxide and hydrogen sulphide. Cleaning to natural gas quality. Odorisation. Utilization of biogases: direct firing, combined heat and power, bio-motor fuels. Biogas utilization systems. Biogas boilers. Biomethane injection into natural gas pipelines. Quality upgrading. Risk factors from the quality of biogases. Quality and quantity boundary conditions of biogas injection into natural gas systems**.**

Compulsory or recommended literature resources:

- ailón, L. - Hinge, J.: Biogas and bio-syngas upgrading Report; Danish Technological Institute, Aarhus, December 2012.
- enry W. (HANK) Poellnitz: Interchangeability of natural gas sources; Southern Natural Gas, 2009.
- ilinski, S. Hauptschriftleiter: STUDIE Einspeisung von Biogas in das Erdgasnets; Institut für Energetik und Umwelt gGmbH; Leipzig, 2006. pp.1-196. ISBN 3-00-018346-9
- .V. Nederlandse Gasunie: Physical properties of natural gases, 1988. pp. 33-212.
- ersson, M. – Jönsson, O. – Wellinger, A.: Biogas upgrading to vehicle fuel standards and grid injection; IEA Bioenergy, December 2006.
- olman, E.A.: GT-070127 Quality Aspects of Green Gas; Kiwa N.V., Rijswijk, the Netherlands, 2007.

COURSE TITLE: Geothermal Energy Production

MFKGT433B
Instructor:
Elemér Bobok, Professor Emeritus
Anikó Nóra Tóth, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:

Behaviour of geothermal energy. Geothermal fields. Significant geothermal reservoirs. Method of the calculation of geothermal potential. Geothermal heat flow. Criterions of the convective heat flow. Simple reservoir models. Flow in porous reservoir. Structures of the geothermal wells. Injection to the reservoir. Heat mining. Flow in the production well. Temperature distribution in the well. Pressure and heat loss in a steam well. Production equipment's: submersible pumps, heat exchangers, heat pumps. Steam and extreme hot water transmission pipelines. Environmental impacts of the geothermal energy production.

Compulsory or recommended literature resources:

- acca, G., Tonani, F.(1964): Theory and technology of a geothermal field, Bull. Volcanologique Vol. 27.1. pp143-189.
- orne, R.N. (1988): Geothermal Energy Assessment", in Geothermal Reservoir Engineering, editor E. Okandan, Reidel.
- c. Nitt (1977): Origin of steam in geothermal reservoirs, SPE Paper 6764
- ybach, L., Muffler, L.J.P.(1981): Geothermal Systems, Wiley, New York

COURSE TITLE: Geothermal Energy Use

	MFKGT434B **Instructor:** **Elemér Bobok, professor emeritus** **Anikó Nóra Tóth, Associate Professor** **Institute of Petroleum and Natural Gas**	**Credits: 5** **Pre-requisites: -**
	Course description: Basic and general questions of geothermal energy use. Geothermal power production. Power plants. Binary cycles. Turbines. Geothermal direct uses. Lindal diagram. Geothermal district heating systems. Agriculture uses. Industrial uses. Balneology uses. Environmental impacts. Geothermal reservoir types. Estimation of the geothermal potential. History of the Hungarian geothermal energy use. Update status of the geothermal energy use in Hungary, Europe and the world. Main and significant projects and case studies.	
	Compulsory or recommended literature resources: ▪ und J.: Direct Heat Utilization of Geothermal Energy Geo Heat Center, Oregon, USA, 2002. ▪ ibach L.-Muffler L.J.R.: Geothermal Systems, John Willey New York, Brisbane, Toronto, 1981.	

COURSE TITLE: Transport Processes in Special Cases

	MFKGT435B **Instructor:** **Elemér Bobok, Professor Emeritus** **Anikó Nóra Tóth, Associate Professor** **Institute of Petroleum and Natural Gas**	**Credits: 5** **Pre-requisites: -**
	Course description: Elements of the geothermal energy production system. Flow- and heat transfer processes in geothermal system. Balance equation: mass, momentum, energy equations. Laminar and turbulent flow. Non-isothermal flow. Pressure and heat loss calculation. Similarity laws. Flow in the reservoirs, wells, surface equipment's (liquid, steam, and mix). Heat transfer in the wells, in the pipelines, in the heat exchanger.	
	Compulsory or recommended literature resources: ▪ sszonyi, Cs., Richter, R.(1979): The continuum Theory of RoMechanics, Trans. Tech. Publ. New York ▪ ird, R.B., Stewart, W.E.,Lightfoot, E.N.(1960): Transport Phenomena, Wiley, New York ▪ obok E. (1978): New concept to describe flow through porous media, Siamog, Granada ▪ arcy, H.(1856): Les fontaines publiques de la ville Dijon, Dalmont, Paris ▪ rusdell, C.,Toupin, R.A.(1960): The Classical Field Theories Encyclopedia of Physics III/1 Springer, Berlin ▪	

ienkiewicz, O.C.(1973): Finite Element Studies of Solid and Porous Madia, UAH Press, Huntsville

COURSE TITLE: Selected Chapters of the Rotary Drilling Technology

MFKOT416B
Instructor:
Imre Federer, Associate Professor
Tibor Szabó, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
The composition of modern rotary drilling rigs. Drillstring components and drillstring design. Loads in the drillstring. The composition of the hoisting system. Rotary drilling bits, drillbit selection. Drilling fluids: composition and measurements. Environmentally friendly handling of drilling fluids. Rig hydraulics, design. Casing design. Cementing. Hole problems, fishing and loss. Basic tasks and hardware of the well completion.

Compulsory or recommended literature resources:

- obert F. Mitchell (Editor): Petroleum Engineering Handbook, Volume II Drilling Engineering , Society of Petroleum Engineers, Richardson, TX, U.S.A. 2006. ISBN 978-1-55563-114-7
- rik B. Nelson (Editor): Well Cementing, Elsevier- Schlumberger Educational Services. Second Edition, Amsterdam, 1990. ISBN 0-444-88751-2
- . Bell, D. Eby, J. Larrison, B. Ranka: Blowout Prevention, 4th Ed. 2009. ISBN 0-88698-242-1.
- rilling Data Handbook, Edition Technip, Paris, 1999. ISBN 2-2108-0756-4

COURSE TITLE: Well Completion

MFKOT417B
Instructor:
Imre Federer, Associate Professor
Tibor Szabó, Associate Professor
Petroleum and Natural Gas Institute

Credits: 5
Pre-requisites: -

Course description:
Well structure design. Overpressure prediction, casing seat selection. Well completion. HC well's production analysis. H2S and CO2 corrosion. Workover fluid design. Wellhead equipment. BOP, casing head, Christmas tree and its components. Tubing design. Tubing stress in gas wells. Determination of the critical velocity in wells. Packer stress, tubing movement, selection of tightening elements. Well completion hardware. Selection of well completion elements. Workover rigs. Slickline, wireline, coiled tubing.

Compulsory or recommended literature resources:

- . Rabia: Oilwell Drilling Engineering. Principles and Practice. Graham Tratman Ltd. London 1995. 322 p.

- oward B. Bradley: Petroleum Engineering Handbook, Third Printing, Society of Petroleum Engineers, Richardson, TX, U.S.A. 1992.
- rilling Data Handbook, Edítion Technip, Paris ISBN 2-2108-0756-4, 1999. 542 p.
- rik B. Nelson: Well Cementing. Schlumberger Educational Services. Second Edition, Houston Texas, 2006.
- rthur Lubinski (Edited by Stefan Miska): Development of Petroleum Engineering I-II. Gulf Publishing Company, Houston, 1987.

COURSE TITLE: Well Control

MFKOT418B
Instructor:
Imre Federer, Associate Professor
Tibor Szabó, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
Drilling and workover operation's safety. The hole's and well's pressure balance. Drilling practices for overpressurized formations. The kick's warning signs. Well shut in procedures. The driller's method, wait&weight method and other unusual methods. Killing of producing wells. Well control equipment. Well control simulation and its practical aspects.

Compulsory or recommended literature resources:

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

COURSE TITLE: Flowing Oil Wells

MFKOT419B
Instructor:
Gábor Takács, Professor
Zoltán Turzó, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
Surface and downhole equipment used in flowing oil wells. Accuracy of the models used for the calculation of multiphase pressure drops in wells. Hydraulic analysis of downhole and

surface chokes. Stability criteria of flowing oil wells. Establishing optimum operating conditions, finding the optimum size of the tubing. Analysis of the operation of flowing oilwells.

Compulsory or recommended literature resources:

- . Szilas: Production and Transport of Oil and Gas. Part A., Akadémiai Kiadó, Budapest, 1986.
- akács Gábor: Fundamentals of Production Engineering., oktatási segédlet, Miskolci Egyetem, 2005.
- . Takács: GAS LIFT MANUAL, PennWell Corporation, Tulsa, USA. 2005.
- eorge V.Chilingarian et.al.: Surface Operations in Petroleum Production II, Elsevier, 1989
- arry W. Lace: General Engineering, Petroleum Engineering Handbook Vol 1, SPE, 2006

COURSE TITLE: Gathering of Crude Oil

MFKOT420B
Instructor:
Gábor Takács, Professor
Zoltán Turzó, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
Components of oilfield gathering systems, description of their operation. Hydraulic conditions of flowlines gathering multiphase mixtures. Rheological conditions of gathering non-Newtonian crude oils. Operating conditions and optimization of two and multiphase separators. Operation of central processing stations, storage and transportation of crude oil. Effects of main parameters of the gathering system on the operating costs of an oilfield.

Compulsory or recommended literature resources:

- . P. Szilas: Production and Transport of Oil and Gas. Part A., Akadémiai Kiadó, Budapest, 1986.
- ugene F. Megyesy: Pressure Vessel Handbook, 14th edition, PennWell, 2008.
- rancis S. Manning, Ph.D. and Richard E. Thompson, Ph.D: Oilfield Processing, Volume 2: Crude Oil, PennWell, 1995.
- eorge V.Chilingarian et.al.: Surface Operations in Petroleum Production II, Elsevier, 1989
- arry W. Lace: General Engineering, Petroleum Engineering Handbook Vol III, SPE, 2006

COURSE TITLE: NODAL Analysis

MFKOT421B **Credits: 5**

	Instructor: **Gábor Takács, Professor** **Zoltán Turzó, Associate Professor** **Institute of Petroleum and Natural Gas**	**Pre-requisites: -**
	Course description: Basic concepts of Nodal Analysis. Hydraulic calculations in the formation, the well, the flowline. Pressure drop calculations in usual equipment in oil and gas wells. Hydraulic analysis of usual well completions. Features and calculation accuracies of procedures used for hydraulic calculations. The most important tasks in the design and analysis of oil and gas wells that can be solved by Nodal Analysis**.**	
	Compulsory or recommended literature resources: ▪ eggs, H. D.: Production Optimization Using NODAL Analysis, OGCI Publications, 2003. ▪ akács, G.: Gas Lift Manual., PennWell Corporation, Tulsa, USA. 2005. 478p, ▪ akács, G.: Sucker-rod pumping handbook. Elsevier, 2015. ▪ akács, G.: Electrical submersible pumps manual. Elsevier, 2009. ▪ holet, H.: Progressing cavity pumps. Editions Technip, Paris. 1997.	

COURSE TITLE: Production Systems of Oil Fields		
	MFKOT422B **Instructor:** **Gábor Takács, Professor** **Zoltán Turzó, Associate Professor** **Institute of Petroleum and Natural Gas**	**Credits: 5** **Pre-requisites: -**
	Course description: Components of production systems and their interaction. Construction of typical production systems. Application of systems (Nodal) analysis for the description of the cooperation of system components. Establishing the limit of flowing production. Analysis of typical costs occurring in production systems. Time variation of operating costs. Basics of technical and economic optimization of production systems, ways to attain optimum conditions. Effects of the crucial parameters on the technical and economic conditions of the system.	
	Compulsory or recommended literature resources: ▪ . P. Szilas: Production and Transport of Oil and Gas Part A., Akadémiai Kiadó, Budapest, 1986. ▪ ugene F. Megyesy: Pressure Vessel Handbook, 14th edition, PennWell,2008. ▪ rancis S. Manning, Ph.D. and Richard E. Thompson, Ph.D: Oilfield Processing, Volume 2: Crude Oil, PennWell, 1995. ▪ eorge V.Chilingarian et.al.: Surface Operations in Petroleum Production II, Elsevier, 1989 ▪	

arry W. Lace: General Engineering, Petroleum Engineering Handbook Vol III, SPE, 2006
▪
eggs, H. D.: Production Optimization Using NODAL Analysis, OGCI Publications, 2003.
▪
akács, G.: Gas Lift Manual., PennWell Corporation, Tulsa, USA. 2005. 478p,
▪
akács, G.: Sucker-rod pumping manual. Tulsa : PennWell, 2003
▪
akács, G.: Electrical submersible pumps manual. Elsevier, 2009.
▪
holet, H.: Progressing cavity pumps. Editions Technip, Paris. 1997.

COURSE TITLE: Sucker-Rod Pumping

MFKOT423B
Instructor:
Gábor Takács, Professor
Zoltán Turzó, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
Components of the sucker-rod pumping system, their interaction. Obtaining the optimum pumping mode. Analysis of the energy conditions of the system, establishing the operating conditions with minimum energy usage. Analysis of the torque conditions of gearboxes, ways to attain optimum counterbalancing conditions. Basics of Nodal Analysis applied to the sucker-rod pumping system. Critical analysis of the methods used to investigate operating conditions, features of the calculation models describing operating conditions. Problems of calculating downhole dynamometer cards, solutions of the wave equation applied to the sucker-rod string.

Compulsory or recommended literature resources:

▪
arry W. Lace: General Engineering, Petroleum Engineering Handbook Vol IV, SPE, 2006
▪
eggs, H. D.: Production Optimization Using NODAL Analysis, OGCI Publications, 2003.
▪
akács, G.: Sucker-rod pumping manual. Tulsa: PennWell, 2003.
▪
akács, G.: Sucker-rod pumping handbook. Elsevier, 2015.

COURSE TITLE: Gas Lifted Production Systems

MFKOT424B
Instructor:
Gábor Takács, Professor
Zoltán Turzó, Associate Professor
Institute of Petroleum and Natural Gas

Credits: 5
Pre-requisites: -

Course description:
Examination of downhole completion of gas lifted wells, determination of optimal well

	completion. Description of the multiphase flow in continuous and intermittent gas lifted wells. Calculation methods to determine the injection gas requirements. Economical effect of the most important operational parameters of gas lifting: injection pressure, tubing size, welhead pressure. Economical effect of elements on the whole gas lifted production system. Design of the surface gas lift supply system, and its effect on the gas requirements. Design of the production system in case of time dependent operational condition.
	Compulsory or recommended literature resources: ▪ . Szilas: Production and Transport of Oil and Gas. Part A., Akadémiai Kiadó, Budapest, 1986. ▪ akács Gábor: Fundamentals of Production Engineering., oktatási segédlet, Miskolci Egyetem, 2005. ▪ . Takács: GAS LIFT MANUAL, PennWell Corporation, Tulsa, USA. 2005. ▪ eorge V.Chilingarian et.al.: Surface Operations in Petroleum Production II, Elsevier, 1989 ▪ arry W. Lace: General Engineering, Petroleum Engineering Handbook Vol 1, SPE, 2006

COURSE TITLE: Underground Fluid Mechanics

MFAKK405B **Instructor:** **Anita Jobbik Ph.D., research fellow** **Research Institute of Applied Earth Sciences**	**Credits: 5** **Pre-requisites: -**

Course description:

The aim of this subject that the candidate gets acquainted with hydraulic-, material-, and thermal processes of fluids moving or filtrating through the porous and double porous medium. The candidates get knowledge of the hydraulical processes of the fluid production (or exploitation hydrocarbon or water) that are taken place in the layers and reservoirs. They get comprehensive knowledge about the flow patterns of hydraulic processes, the rock, the fluid properties that influence the flow in the reservoir, and general mathematical equations by which these processes can be calculated. This subject give information about how one can influence and control the flow patterns and systems of single or multi phase flow around or between the wells that were drilled in the reservoirs.

Compulsory or recommended literature 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

COURSE TITLE: Applied Physical Chemistry

MFAKK404B **Instructor:** **Prof. István Lakatos, academician** **Research Institute of Applied Earth Sciences**	**Credit: 5** **Pre-requisites: successful examination in Physical Chemistry at BSc. and MSc. levels**

Course description:

Definition of physical chemistry and its theoretical approaches. Intensive and extensive parameters, types of equilibria, and equation of state. Laws of ideal and real gases and kinetic theory of gases. Fundamentals of thermodynamics and first, second and third laws of thermodynamics. Definition of enthalpy and entropy, heat capacity and adiabatic processes The discrete and generalized Carnot cycle. Concept of thermodynamic equilibrium and the chemical potential. Homogeneous and heterogeneous reaction equilibrium. Dependence of equilibrium constant on temperature and pressure. Solubility equilibrium of liquids and gases, partition phenomena. Equilibrium in multiphase systems, the critical phenomena. Fundamentals of distillation and extraction. Colligative properties of multicomponent systems. Kinetics of chemical systems, chain reactions. Influencing of rate of chemical reaction, catalysis, and inhibition of reactions. Transport phenomena including basis of different sorption processes (adsorption, absorption, capillary condensation, and chemisorption). Fundamentals of diffusion in gases, liquids, and fluids. Basis of rheology, Newtonian and non-Newtonian flow behavior. Different types of non-Newtonian behavior ad equations modelling the non-Newtonian fluids. Effect of temperature on liquids and gases. Fundamentals and classification of colloid systems. Definition of bulk phase and surface forces. Capillary phenomena, imbibition of fluids in pores and capillaries (capillary elevation and depression). Definition of capillary pressure. Spreading of fluids on immiscible fluid and solid surfaces. Macro- and microheterogeneous dispersed systems. General properties of emulsions and suspensions. Stability of colloid chemical systems, role of surface charge in stabilization and destabilization of dispersed systems focusing on oil containing emulsions and suspensions**.**

Compulsory or recommended literature resources:

- P. W. Atkins: Physical Chemistry, Oxford University Press, Oxford, UK (2001)
- K. J. Laidler, J. H. Meiser: Physical Chemistry, Houghton Mifflin Company, Boston, USA (1999)

COURSE TITLE: Applied Oilfield Chemistry

	MFAKK411B **Instructor:** **Prof. István Lakatos, academician** **Research Institute of Applied Earth Sciences**	**Credits: 5** **Preconditions: successful examination in General Chemistry and Physical Chemistry subjects of BSc and MSc levels**
	Course description:	

	Elemental and group composition of crude oils and natural gases. Classification of crude and natural gases. Fundamentals of phase behavior of single-, two-, and multiphase systems. Phenomena of super critical and retrograde behavior. Surface and interfacial properties of oil, gas, water and their composite systems. Factors influencing surface and interfacial tension at ambient and HTHP conditions. Deliberate alteration of ST and IFT, and materials used to thereon. Bulk and interfacial rheological properties single- and multicomponent fluid systems. Solubility equilibria of non- or partially miscible fluids systems. Interaction of fluid (oil, water, and gas) with reservoir rocks. Fundamentals of wettability, clay swelling and disintegration, and ion exchange processes. Consequences of detrimental effects responsible for declined well performance. Methods applied for prevention and cure of sanding and fine migration causing increased skin factor and collapse of bottomhole region in wells. Colloid chemical solutions and technologies used to stimulate wells lost fluid lifting. Types of chemicals used in treating solution, micro- and macroemulsions, foams and gels to overcome detrimental effects. Chemical basis and materials of mud chemistry, fracturing and completion fluids and matrix acidizing. Accumulation of asphaltenes, paraffins, and other high molecular weight components of crude oils in the bottomhole. Technologies to remove the accumulated depositions using aqueous and organic solutions, microemulsions, and foams. Scale formation in the nearby region of bottomhole and surface facilities. Mechanical and chemical methods of scales and materials to inhibit scale formation. New trends in oilfield chemistry. Environmental questions of oilfield chemistry, removal of hydrocarbon contamination from water and solid surfaces**.**
	Compulsory and recommended literature resources ▪ lide Show of subject (I. Lakatos) ▪ . W. Frenier, M. Ziauddin: Chemistry for Enhancing the Production of Oil and Gas, SPE, Richardson, USA (2014) ▪ akatos, I.: Progress in Oilfield Chemistry I-IX, Akadémiai Kiadó, Budapest (1999-2011)

COURSE TITLE: Chemical Methods of Intensive Oil and Gas Recovery		
	MFAKK414B **Lecturer:** **Prof. István Lakatos, academician** **Research Institute of Applied Earth Sciences**	**Credit: 5** **Preconditions: successful examination in Reservoir Engineering and Chemistry at BSc and MSc levels**
	Course description: Classification of IOR/EOR Methods. Fundamentals of chemical enhanced oil recovery. Factors influencing recovery factors including heterogeneity of reservoir rocks and surface/interfacial properties of multiphase systems. Definition of microscopic displacement and sweep efficiency. Options to increase displacement efficiency: fundamentals of surfactant and alkaline flooding. Mechanism of surfactant and alkaline flooding focusing on field application under HTHP conditions. Different varieties of surfactant flooding using diluted and micellar solution and microemulsions and combined surfactant/alkaline (SA) flooding. Field experiences of surfactant flooding. Mechanism of alkaline flooding:	

	wettability alteration and saponification in the presence of weak and strong alkalis. Field experiences of alkaline flooding. Theoretical role of mobility control in oil and gas recovery. Fundamentals of mobility control and reservoir conformance control using water-soluble polymer solutions and gels. Mechanism of polymer flooding: effect of rheological properties and polymer adsorption/retention on sweep efficiency. Types of polymers applied and their effect on flow phenomena in porous media. Field experiences of polymer flooding and its combination with surfactants and alkaline materials (ASP, SP and P technologies). Improvement of recovery factor by local control of flow characteristics using gel technology. Theoretical aspects of well treatment techniques aimed at flow profile control. Options of reservoir conformance control in oil and gas fields. Practical aspects of selective flow control in reservoirs and the appropriate surface technology. Future of chemical IOR/EOR methods, new directions, materials, and concepts. The teaching program is based on lectures and consultant support personal learning.
	Compulsory and recommended literature resources: ▪ stván Lakatos (ed.): Progress in Oilfield Chemistry, Vol. 1-9., Akadémiai Kiadó, Budapest, (1999-2011 ▪ . Ahmed: Reservoir Engineering Handbook, Gulf Publishing Co., 2001, ISBN 0-88415-770-9 ▪ . P. Lake, R. T. Johns, W. R. Rossen, G. A. Pope: Fundamentals of Enhanced Oil Recovery, SPE, Richardson, USA (2014)

Research area: Environmental Processing and Raw Material

COURSE TITLE: Soil cleaning		
	Instructor/ Responsible department/institute: ***Dr Ljudmilla BOKÁNYI PhD, CSc*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other): essay and exam***
	Description*:* Biological aspects of soil protection. Characterization of soils, their properties and types. Legal issues. Soil contamination and ground water pollution. Mobility of soil contaminants and their interactions with soil components. Theoretical background, conditions, equipment and realisation of - physical-chemical - chemical - biological processes. Technological layout and technological design. Laboratory modelling of soil cleaning.	
	Compulsory or recommended literature: Groundwater and Soil Clean-up: Improving Management of Persistent Contaminants, Committee on Technologies for Clean-up of Subsurface Contaminants in the DOE Weapons Complex, National Research Council. ISBN: 0-309-51961-6, 304 pages, 6 x 9, (1999) Innovations in Ground Water and Soil Clean-up: From Concept to Commercialization Committee on Innovative Remediation Technologies, National Research Council ISBN: 0-309-52148-3, 310 pages, 6 x 9, (1997) Bajpai, R.K.-Zappi, M.E.: Bioremediation of Surface and Subsurface Contamination. New York Academy of Sciences, 1997. ISBN:1-57331-065-4 Noyes, R.: Unit operations in Environmental Engineering. Noyes Publications, USA, 1994. Periodical SCI Journals http://www.epa.gov/superfund/remedytech/remed.htm	

COURSE TITLE: Flow properties of suspensions		
	Instructor/ Responsible department/institute: ***Dr József Faitli, PhD*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Physical characterization of suspensions. Rheology of liquids. Rheology of solid – liquid mixtures. Newtonian and non-Newtonian liquids and suspensions. Rheological testing: Tube rheometers. Rheological testing in tube rheometers, evaluation of non-Newtonian pseudo- shear curves. Rotational rheometers. Rheological testing in rotational rheometers, evaluation of non-Newtonian pseudo- shear curves. Viscometers: falling body and other viscometers. Rheological properties of high viscosity fluids.	
	Compulsory or recommended literature: J. Faitli, I. Gombkötő: Some technical aspects of the rheological properties of high concentration fine suspensions to avoid environmental disasters. Journal of Environmental Engineering and Landscape Management. http://dx.doi.org/10.3846/16486897.2015.1021698. (2015) Tarján G.: Mineral Processing (Vol. 1, 2). AK. Bp.1981 Horsley M.R., Horsley R.R., Wilson K.C., Jones R.L.: Non-Newtonian effects on fall velocities of pairs of vertically aligned spheres. J. Non-Newtonian Fluid Mech. 124 (2004) 147-152 Matousek, V.,: Effect of solids distribution near a pipe wall on flow friction in a slurry pipeline. The 4th International Conference for Conveying and Handling of Particulate Solids. Budapest, Hungary, Proceeding: pp. 13.19 – 13.24. (2003) Sengun M.Z., Probstein R. F.,: Bimodal model of slurry viscosity with application to coal slurries, Part I. Rheologica Acta, vol. 28, p. 382, (1989), Part II, Rheologica Acta, vol. 28, p. 394, (1989) Bőhm, J. – Debreczeni, Á. – Faitli, J. – Gombkötő, I. – Meggyes, T.: „High-concentration hydraulic transport of tailings" Land Contamination & Reclamation, Volume 15, Number 2, *pp. 195 – 217*, 2007. (ISSN 0967-0513)	

COURSE TITLE: Preparation of municipal solid wastes, MFC436		
	Instructor/ Responsible department/institute: ***Dr Sándor Nagy, PhD*** ***Lecturer*** ***Institute of Raw Material Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Mechanical processes and equipment of municipal solid waste processing plants: build up and technical properties of bag openers, comminution devices, screens, magnetic-, and eddy-current separators, hand-, and automatic sorting belts. Work-, and environmental protection equipment: dust extractor, air filter, air conditioning. Build-up of sorting plants. General technological-technical requirements. Operation of technological process: reception of waste, pre-selection, feeding, separation by size, hand-, and automatic sorting by quality, baling and storing. Positive and negative sorting. Sorting capacities of different wastes. Determination of material balance of sorting plant. Determination of the sorting belt and sorting headcount. Low and high mechanised technological systems (one belt and two belts). Arrangement of equipment of sorting plant: sorting cabin, build-up of collecting-, belts and boxes. Build-up of site. Profitability of sorting plant. Secondary fuel production from municipal solid waste. Technologies and equipment (comminution, classification and separation).	
	Compulsory or recommended literature: Worrell, W. A. – Vesilind, P. A.: Solid Waste Engineering. Cengage Learning, Stamford, 2012. Tchobanoglous, G.- Kreith, F.: Handbook of Solid Waste Management. McGRAW-HILL, New York, 2002. Tchobanoglous, G.-Theisen, H.-Vigil, S.: Integrated Solid Waste Management. McGraw-Hill, Inc., New York, 2002.	

COURSE TITLE: Physical separation technologies, MFC434

	Instructor/ Responsible department/institute: ***Dr József Bőhm, CSc*** ***Dr Imre Gombkötő, PhD*** ***Associate professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* The aim of the course is introducing separation process of solid disperse systems based on differences of the properties of their components. The course includes: • mechanical and physical properties of particulate systems, • methods of changing physical properties, • principals of gravity, magnetic, electric, optic, thermic and mechanical separation, • required condition and circumstances of successful separation, • process technology components and their design and dimensioning practice, new scientific trends and achievements of the field.	
	Compulsory literature: G Tarján: Mineral Processing I-II., Akadémia kiadó Budapest, 1986 R. P. King: Modelling and Simulation of Mineral Processing Systems, Butterworth-Heinemann 2001, ISBN:0750648848 **Recommended literature:** Errol G. Kelly, David J. Spottiswood Introduction to mineral processing Wiley, 1982 Ashok Gupta, Denis Yan, Mineral Processing Design and Operation: An Introduction Elsevier Science 2006 ISBN: 0444516360 Maurice C. Fuerstenau, Kenneth N. Han Principles of Mineral Processing SME, 2003 ISBN: 0873351673 Barry A. Wills, Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology Books ISBN: 0750644508	

COURSE TITLE: Physical-Chemical Separation

	Instructor/ Responsible department/institute: ***Dr Ljudmilla BOKÁNYI PhD, CSc*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other): essay and exam***
	Description*:* Physical-chemical characterization of the disperse solid, liquid and disperse gaseous phases. Interfacial phenomena. Interfacial interactions and their control using electrolytes, tenzides and colloids. Separation techniques based on the physical-chemical properties: - Froth fractionizing - froth flotation - gamma-flotation - ultra flotation - ion flotation - electro flotation - emulsion flotation. Flotation kinetics. Flotation equipment. Flotation technologies.	
	Compulsory or recommended literature: Maurice C. Fuerstenau, Kenneth N. Han: Principles of Mineral Processing SME, 2003, ISBN: 0873351673 Barry A. Wills, Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology Books ISBN: 0750644508 SME Handbook of Mineral Processing. Ed.: Weiss, N. L. USA, 1985 ISBN: 0895204436, Periodical SCI Journals, Proceedings of the International Mineral Processing Congresses.	

COURSE TITLE: Waste water treatment

	Instructor/ Responsible department/institute: ***Dr Ljudmilla BOKÁNYI PhD, CSc*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other): essay and exam***
	Description*:* Water protection: biological aspects, quality definitions, water cycle, water consumption, water contamination, waste water, self-cleaning of natural reservoirs. Aims and tasks of water management. Legal issues. Aim of waste water treatment. Relationships between water quality protection and water management and the waste water treatment. Theoretical background, conditions, equipment, reactors and realisation of - mechanical - chemical - physical-chemical - biological water treatment techniques. Technologies for municipal and industrial waste water treatment, their selection, design and optimisation, dimensioning. Laboratory modelling. Sewage sludge characterisation and handling.	
	Compulsory or recommended literature: H. Brauer (Hrsg): Handbuch des Umweltschutzes und Umweltschutztechnik. Band 4. Additiver Umweltschutz: Behandlung von Abwasser; Springer-Verlag Berlin Heidelberg, 1996. Hartinger, L. (1994): Handbook of *Effluent* Treatment and Recycling for the *Metal Finishing Industry*, *Finishing* Publications Ltd & ASM International, 2nd ed Handbook of Water and Wastewater Treatment Technologies, *Nicholas P. Cheremisinoff, Ph.D.,* ISBN: 978-0-7506-7498-0 Periodical SCI Journals	

COURSE TITLE: Coal preparation		
	Instructor/ Responsible department/institute: ***Dr József Bőhm, CSc,*** ***Titular Professor*** ***Dr Imre Gombkötő*** ***Associate professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* The aim of this course is introducing wet and dry coal preparation process and basic knowledge on design and operation of coal preparation plant. The course also includes: • coal genesis and component, • physical properties of the coal and their components - coal classification, • wet and dry coal preparation processes and their principals, • sulphur removal techniques based on its form and appearance, • coal briquetting techniques, and its principals, • coal applications, including „Clean Coal Technology, • Basics of utilisation of coal preparation and utilisation residues, new scientific trends and achievements of the field.	
	Compulsory and recommended literature: Arnold, Barbara J._ Klima, Mark S._ Bethell, Peter J. (Eds.): Designing the Coal Preparation Plant of the Future-Society for Mining, Metallurgy, and Exploration (SME) (2007) Bruce G. Miller: Clean Coal Engineering Technology-Butterworth-Heinemann (2011) Leonard, Joseph W., III (Eds.): Coal Preparation-Society for Mining, Metallurgy, and Exploration (SME) (1991)	

COURSE TITLE: Particle design		
	Instructor/ Responsible department/institute: ***Dr Barnabás Csőke, CSc,* Dr.habil** ***Professor*** ***Dr Ádám Rácz*** ***Researcher*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Particle and product design in mineral processing. Tailoring the dispersity (particle size, specific surface, particle shape, interfacial properties) and structural properties (crystal structure, amorphity, texture, inhomogeneity inside the particle) of the material during grinding and fine grinding. Tailoring the product properties by functions. Explanation of the material, mill and process function and the connections between them. Particle shaping in stirred media mill. Particle coating.	
	Compulsory literature: Peukert, W. (2004): Material properties in fine grinding. International Journal of Mineral Processing, 74, S3–S17. doi:10.1016/j.minpro.2004.08.006 Powder Technology – relevant articles of the last five years **Recommended literature:** Minerals Engineering – relevant articles of the last five years International Journal of Mineral Processing – relevant articles of the last five years	

COURSE TITLE: Optimisation and process control of grinder-classifier systems

	Instructor/ Responsible department/institute: ***Dr Barnabás Csőke, CSc,* Dr.habil** ***Professor*** ***Dr Gábor Mucsi, PhD*** ***Associate professor*** ***Dr Ádám Rácz*** ***Researcher*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Types and parts of the grinder-classifier systems. Layout and types (ball-, vertical roller mill, air separator, hydrocyclone) of the equipment. Theoretical basis of the grinding circuits process control. Process control of the closed circuit grinding-classifying systems. Task of the control, basic properties of the controlling system. Process control of the dry and wet grinding-classifying systems. Controlling system of a continuous working wet stirred media milling. Traditional and fast grindability measurement methods and equipment for the control and check of industrial grinding (Bond, Zeisel, Universal Hardgrove methods). Grindability measurements for special circumstances (high temperature and/or acidic/alkaline medium). Correlation between the grindability and material properties. Criteria of the online grindability measurement.	
	Compulsory literature: Tarján G. (1981) Mineral Processing, Akadémiai kiadó, Budapest Mular A. L. – Jergensen G. V.: Design and installation of Comminution Circuits. Port City Press, Baltimore. 1982. Lynch, A.J.: Mineral Crushing and Griding Circuits, Their Simulation, Optimization Design and Control, Elsevier, Amsterdam-Oxford-London, 1977 **Recommended literature:** Barry A. Wills, Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology Books ISBN: 0750644508 Weiss N. L. (editor): SME Mineral Processing Handbook. Volume I. II. Kingsport Press, Kingsport. 1985. Minerals Engineering, International Journal of Mineral Processing, Powder Technology – relevant articles of the last five years	

COURSE TITLE: Flow, feed and storage of bulk materials		
	Instructor/ Responsible department/institute: ***Dr József Faitli, PhD*** ***Associate professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Physical properties of bulk solids. Comparison between viscous flows versus powder flow. The uniaxial compression test. Principles of shear testing. Representation of stresses using Mohr stress circles. Stresses in vertical channels (Janssen). Consolidation of bulk solids. Time consolidation. Yield locus and flow properties. The Jenike powder flow test device. Mass flow and funnel flow silos. Principles of silo design. Feeders and dischargers. Selection of feeders and dischargers.	
	Compulsory and Recommended literature: Jenike A. W.: Storage and flow of solids. Bulletin of the University of Utah, 1964. Tarján G.: Mineral Processing (Vol. 1, 2). AK. Bp.19813 McQuiston – Shoemaker: Primary Crushing Plant Design. Port City Press. Baltimore, 1978. Barry A. Wills - Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology Books ISBN: 0750644508 Weiss N. L. (editor): SME Mineral Processing Handbook. Volume I. II. Kingsport Press, Kingsport. 1985. Mular A. L. – Jergensen G. V.: Design and installation of Comminution Circuits. Port City Press, Baltimore. 1982.	

COURSE TITLE: Technological design of raw material preparation systems		
	Instructor/ Responsible department/institute: ***Dr Barnabás Csőke, CSc,* Dr.habil** ***Professor*** ***Dr Ádám Rácz*** ***Researcher*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Technological systems. Layout and build-up of processing plants. Processing models. Algorithm of one- and more stage, open and closed circuits, determination of the material flow rate. Application of the computer supported processing design: application of simulations for the design of the processing plant technology, selection and design of equipment. Determination of the processing equipment main sizes and operational parameters. Determination of the investment and operational cost of the processing plants. Case studies: classifying, comminution, grinding plant design.	
	Compulsory literature: Tarján, G.: Mineral Processing. Akadémiai Kiadó (Printed in Hungary: ISBN 953 05 2243 8), Buda-pest 1981. Vol.1 (pp.1-573) Weis, N.L. (Edit.): SME Mineral Processing Handbook. Volume 1-2, Society of Mining Engineers of AIM(MP)E, New York, 1985 **Recommended literature:** Mular, A.L.- Jergensen, G.V.: Design an Installation of Comminution Circuits. Society of Mining Engineers of AIM(MP)E, New York, 1982 Chrushing and Screening Handbook (Fourth Edition), Metso's Mining and Construction Technology, Tampere (Finland), 2009 Lynch, A.J.: Mineral Crushing and Griding Circuits, Their Simulation, Optimization Design and Control, Elsevier, Amsterdam-Oxford-London, 1977 Journal of Mineral Processing (Special Issue Supplement): Comminution 2002. ELSEVIER. Vol.74, 10 December 2004, (ISSN 0301-7516)	

COURSE TITLE: Plastic recycling

	Instructor/ Responsible department/institute: ***Dr Imre Gombkötő, PhD*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* The aim of this course is to introduce general conditions and circumstances of plastic separation and recycling. The course includes: • physical - mechanical properties of structural and main plastic types, • condition and circumstances of their successful separation • plastic waste crushing, separation and granulating technologies • waste composition of typical plastic bearing waste streams • plastic recovery of different waste streams and also their special separation issues • special techniques and issues of plastic waste processing new scientific trends and achievements of the field.	
	Compulsory literature: Plastic technology handbook: Manas Chanda, Salil K. Roy (2006) CRC Press Plastic Waste -Feedstock Recycling, Chemical Recycling and Incineration Tukker (2002) REPRA Technology Ltd. **Recommended literature:** Degradable polymers recycling, and plastics waste management: Ann-Christine Albertsonn and Samuel J Huang (1995) Marcel Decker Inc. Recycling of Plastic Materials Edited by La Mantia, F.P. © 1993; ChemTec Publishing/William Andrew Publishing Plastics materials and processing 3rd edition: A: BRent Strong, (2006) Pearson Preaton Hall	

COURSE TITLE: Basic phenomena and micro processes in mechanical processing		
	Instructor/ Responsible department/institute: ***Dr Ljudmilla BOKÁNYI PhD, CSc*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other): essay and exam***
	Description*:* Physical and physical-chemical properties of solid disperse, liquid and gaseous phases. Their measuring and characterisation by discrete values and mathematical statistical distributions. Phenomena and micro processes taking place in the many-phase systems: agglomeration, adhesion, adsorption, hydrofobization and hydrofilization. Evaluation of experimental results, processing interpretation. Mathematical description of the basic phenomena and micro processes.	
	Compulsory or recommended literature: R.P. King.: Modelling and Simulation of Mineral Processing Systems, Butterworth-Heinemann 2001, ISBN:0750648848 G Tarján: Mineral Processing I-II. Akadémiai Kiadó, Budapest, 1981, 1986. Periodical SCI Journals, Proceedings	

COURSE TITLE: Air cleaning, dust separation technologies		
	Instructor/ Responsible department/institute: ***Dr József Faitli, PhD*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Natural and anthropogenic air pollutants and their physical properties. Effect of air pollutants on the living and built environment. Analysis of dust emission and imission. Dust transmission. Isokinetic imission and emission sampling. Principles of dust separation technologies design. Qualitative design: cut size, total dust recovery, selection (Tromp) function. Economical design: pressure loss calculation. Main types of dust separators of environmental engineering. Dust separation in gravity, dust cyclones, wet dust separators, bag filtering and electrostatic dust separators.	
	Compulsory or recommended literature: Akira Ogawa: Separation of particles from air and gases. CRC Press. 1984. Barry A. Wills: Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology Books ISBN: 0750644508 H. E. Hesketh: Air Pollution Control. Technomic Publication, 1996. (ISBN 1-56676-413-0) A. G. Clarke (editor), Industrial Air Pollution Monitoring. Chapman & Hall, 2012. (ISBN 978-94-010-7143-7)	

COURSE TITLE: Environmental chemistry		
	Instructor/ Responsible department/institute: ***Dr János Takács, CSc*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* *Basis and task of the environmental chemistry. Pollution limits. Ecological basic concepts, main ecological parameters, toxicological basis. Biological aspects of the air, water and soil protection. Reactions in the atmosphere, hydrosphere and lithosphere, circulation of the elements. Pollutants and their behaviour. Natural and anthropogenic pollutants and the environmental chemistry. Waste as a pollutant, pollutants from waste disposal, and firing. Sample taking from liquid, soil, air and waste. Sample preparation. Pollutant measurement methods and standards.*	
	Compulsory or recommended literature: Periodical SCI Journals, Proceedings	

COURSE TITLE: Mixing and homogenization		
	Instructor/ Responsible department/institute: ***Dr József Faitli, PhD*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Characterization of the mixed state. The random uniform state of mixing. Mixing of granular materials. Mixing of liquids. Power requirement of mixing. Main types of mixers. Homogenization. Suspension creation and suspending. Suspension creation in propeller and in flow type mixers. Mixing for heat transfer. Mixing of high viscosity liquids. Emulsification. Gas in-blowing, creating gas – liquid disperse systems.	
	Compulsory or recommended literature: Tarján G.: Mineral Processing (Vol. 1, 2). AK. Bp.1981 Wilson, K. C., Clift, R., Sellgren, A., (2002): Operating points for pipelines carrying concentrated heterogeneous slurries. Powder Technology 123. pp. 19 – 24. Wilson, K. C., Sanders, R. S., Gillies, R. G., Shook, C. A.,(2010): Verification of the near – wall model for slurry flow. Powder Technology. 197. pp. 247 – 253 Tarján, I. – Faitli, J.: Solid-Liquid Mixing in a Vessel by Vertical Flow, In: Lakatos I (ed.) Recent Advances in Enhanced Oil and Gas Recovery. (Progress in Mining and Oilfield Chemistry; Vol. 3.) Budapest: Akadémiai Kiadó - Elsevier Science Publishers, 2001. pp. 245-254. (ISBN: 963 05 7815 8) Faitli, J. – Tarján, I.: „Scale-up Methods of Dense Slurry Production by Propeller and Flow Technique Mixers" Abstracts of the XXII. International Mineral Processing Congress. Chief Editors: L. Lorenzen and D.J. Bradshaw. pp. 452-453, Cape Town, South Africa, 2003. (extended abstract and poster) (ISBN: 0-9584663-4-3)	

COURSE TITLE: Flow of mixtures

	Instructor/ Responsible department/institute: ***Dr József Faitli, PhD*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Physical characterization of coarse disperse systems. The fine suspension flow, the coarse mixture flow and the coarse mixture flow in the fine suspension flow models. Drag on particles in moving fluids. Calculation of the pressure loss of solid – liquid and solid – gas two phase flows in horizontal and vertical pipes. Main technical parameters of hydraulic and pneumatic transport technologies.	
	Compulsory or recommended literature: Tarján G.: Mineral Processing (Vol. 1, 2). AK. Bp.1981 Wilson, K. C., Clift, R., Sellgren, A., (2002): Operating points for pipelines carrying concentrated heterogeneous slurries. Powder Technology 123. pp. 19 – 24. Wilson K. C., Horsley R.R., Kealy T., Reizes J.A., Horsley M. (2003): Direct prediction of fall velocities in non-Newtonian materials. Int. J. Miner. Process. 71 pp. 17-30 Wilson, K. C., Sanders, R. S., Gillies, R. G., Shook, C. A., (2010): Verification of the near – wall model for slurry flow. Powder Technology. 197. pp. 247 – 253 Faitli, J.: ”Pressure Loss Calculation Model for Well-Graded Solid-Liquid Pipe Flows on the Basis of Systematic Pilot Plant Investigations” Intellectual Service for Oil and Gas Industry: Analysis, Solution, Perspectives Co-Proceedings of Ufa State Petroleum Technical University and University of Miskolc, Ufa 2000. pp. 212 – 221 (ISBN 5-7831-0311-X) Tarján, I. – Faitli, J.: ”Distinction of Fine Suspension Flow from Coarse Mixture Flow by Measuring the Pressure Loss in a Horizontal Pipe” In: Lakatos I (ed.) Challenges of an Interdisciplinary Science. (Progress in Mining and Oilfield Chemistry; Vol. 1.) Budapest: Akadémiai Kiadó - Elsevier Science Publishers, 1999. pp. 285-292. (ISBN: 963 05 7655 4)	

COURSE TITLE: Preparation of industrial waste materials		
	Instructor/ Responsible department/institute: ***Dr Gábor Mucsi, PhD*** ***Associate Professor*** ***Institute of Raw Material Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Types of the silicate- and aluminosilicate bearing waste materials. Their quality and quantity produced yearly worldwide. Generation and types of power station fly ash and slags. Physical and chemical properties of fly ash (FA), their environmental impact. Conventional utilization methods (filler material, cement industrial raw material, mine backfill material). Generation, types and composition of metallurgical slags. Utilization of converter slag as concrete aggregate. Preparation of granulated blast furnace slag (GBFS) in order to use as alternative binder material. Construction industrial waste materials and their generation. Utilization and preparation of excavated soil, road construction and demolition waste, wastes of structural engineering, construction site wastes. Processing apparatuses and technologies. New preparation processes and technologies for the treatment of silicate- and aluminosilicate bearing waste materials: mechanical activation (MA) by grinding, effect of classification on the properties of the final product. Alkali activated materials, geopolymer, micro-binder, cenospheres, and encapsulation of hazardous and nuclear waste. Special apparatuses developed for waste preparation, single and multiple stage technologies. Dry and wet technologies..	
	Compulsory or recommended literature: J. Davidovits (2011): Geopolymer chemistry and application. Published by: Institut Geopolimére 16. rue Galilée F-02100 Saint-Quentin France, ISBN: 9782951482050 pp. 283, 286. Sear, Lindon K.: The Properties and Use of Coal Fly Ash. Thomas Telford, London, UK 2001 Recently published issues of the Journal of Ceramics International, Journal of Cement and Concrete Composites, Cement International	

COURSE TITLE: Waste management		
	Instructor/ Responsible department/institute: ***Imre Gombkötő, PhD*** ***Associate Professor*** ***Dr. Sándor Nagy, PhD*** ***Lecturer*** **Institute for Raw Material Preparation and Environmental Processing**	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Waste management, waste utilisation and waste processing. Economic and environmental significance of waste generation and recycling. Main concepts of waste management, definitions: process engineering properties of industrial and communal wastes, municipal solid waste, municipal lumber, municipal style industrial waste, packaging materials and equipment. Sampling, analysis and evaluation for the determination of composition. Determination of mass balance, quantitative estimation of generated waste. Efficiency of selective collection and processing on the basis of the experience of the developed countries. Complex integrated handling system of wastes. Reduction of waste generation, selective collection, mechanical processing, treatment of residues, slag-treatment, landfilling. Objective and result of the selective collection and preparation. Processes and equipment of selective collection. Additive and integrated selective collection processes: aspects of the selection of the collection system. Technical properties and economic indicators of diverse solutions. Equipment of selective collection. Design and operation of collection system. Introduction of the systems in developed countries: Germany (DSD, Grüne Tonne), France (Éco-Emballages), Austria. Economic questions of selective collection and sorting.	
	Compulsory or recommended literature: W. A. Worrell, P. A. Vesilind: Solid Waste Engineering. Cengage Learning, Stamford, 2012. Chongrak Polprasert (2007): Organic Waste Recycling Technology and Management. IWA Publishing	

COURSE TITLE: Special applications of fine grinding

	Instructor/ Responsible department/institute: ***Dr Gábor Mucsi PhD,*** ***Associate Professor*** ***Dr Ádám Rácz PhD,*** ***Researcher*** ***Institute of Raw Material Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description: Mechanism of fine grinding. Apparatuses of fine grinding (ball mill, vibrating mill, stirred media mill, ring mill), main dimensional and operating parameters. Phenomena (obstacles) occurring during fine grinding (aggregation, agglomeration). Effect of mechanical and mechanochemical activation on the material properties concerning its dispersion characteristics and mineralogical composition. Fundamentals of mechanical alloying. Design and working principle of the high energy density mills, with special regards to the stirred media mills. Operation of the continuous working special designed nano-mills. Stress models, stress number, stress intensity theories. Process engineering design of fine grinding mills. Characteristics of dry and wet grinding, effect of the main dimensional and operating parameters (velocity, diameter and shape of grinding media, material of liners and media, size of grinding chamber, filling ratios, etc…) on the fineness of the ground product. Investigation of the relationship between particle size and specific grinding energy. Stabilization methods of suspensions of wet ultrafine grinding: steric, electrostatic and electrosteric stabilization, advantages and disadvantages. Types, properties and mechanisms of grinding aids applied in dry grinding.	
	Compulsory or recommended literature: Juhász A. Z., Opocky L. (1990): Mechanical activation of minerals by grinding, pulverizing and morphology of particles. Akadémiai kiadó, Budapest and Ellis Horwood Limited Kwade, A, (2004): Mill selection and process optimization using a physical grinding model, International Journal of Mineral Processing 74S S93-S101. Kwade, A, (1999): Determination of the most important grinding mechanism in stirred media mills by calculation stress intensity and stress number, Powder Technology 105, p. 382-388. Recently published issues of the following journals: Minerals Engineering, International Journal of Mineral Processing, Powder Technology.	

COURSE TITLE: Metal recycling

	Instructor/ Responsible department/institute: ***Dr József Bőhm. CSC*** ***Titular Professor*** ***Dr Imre Gombkötő PhD,*** ***Associate Professor*** ***Dr Barnabás Csőke, Dr.habil ,*** ***Professor*** ***Institute of Raw Material Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description: The aim of this course is to introduce general conditions and circumstances of metals separation and recycling. The course includes: • appearance forms of metals in different waste streams and their physical - mechanical properties • main process of metal recovery from different waste streams, their equipment and technologies • waste composition of typical metal bearing waste streams (like: mining and processing wastes, slags, metallurgical slags, ELV and WEEE, cables) • metal recovery of different waste streams and also their special separation issues • special techniques and issues of metal waste processing new scientific trends and achievements of the field.	
	Compulsory or recommended literature: Ramachandra Rao, Elsevier B.V: Resource Recovery and Recycling from Metallurgical Wastes.. 2006 (-Chapter 7 Metal recycling Fathi Habashi: Handbook of extractive metallurgy Volume 1-4 WIley-VCH, 1997 Mark E. Schlesinger: Aluminium recycling. CRC Press, 2007 Electronic Waste Management, Issues in environmental science and technology. Editors: R.E. Hester and R.M. Harrison. RSC Publishing, 2009	

COURSE TITLE: Phase separation		
	Instructor/ Responsible department/institute: ***Dr József Faitli, PhD*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Bond between particles. Interfacial tension, capillarity. Liquid bonds in granular materials. Mechanical separation processes for solid – liquid disperse systems. Surface filtering, in depth filtering and counter flow filtering. Gravity filtering, vacuum filtering, pump driven filtering, press filtering. Filtering centrifuges. Separation by sedimentation (thickening and dewatering). Horizontal and vertical flow gravity thickeners. Settling centrifuges. Drying, thermal phase separation. Phase separation of solid – gas disperse systems. Dust separation in gravitational and centrifugal fields. Electrostatic dust separation. Wet dust separation	
	Compulsory or recommended literature: Akira Ogawa: Separation of particles from air and gases. CRC Press. 1984. Barry A. Wills, Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology Books ISBN: 0750644508 H. E. Hesketh: Air Pollution Control. Technomic Publication, 1996. (ISBN 1-56676-413-0) A. G. Clarke (editor): Industrial Air Pollution Monitoring. Chapman & Hall, 2012. (ISBN 978-94-010-7143-7) Stieβ, M: Mechanische Verfahrenstechnik 1,2. Springer (Lehrbuch) 1995	

COURSE TITLE: Ore dressing		
	Instructor/ Responsible department/institute: ***Dr Ljudmilla BOKÁNYI PhD, CSc*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other): essay and exam***
	Description*:* Defining and economy of ore dressing. Processing of iron- and manganese ores. Processing of copper- and complex sulphide ores. Processing of nickel- wolfram-, molybdenum and tin ores. Processing of alkali metals ores. Processing of non-metallic ores: fluorite, barite, feldspars, and phosphates. Processing of gold-containing ores and alluvial gold. Dressing of precious and semi-precious stones. Specific character of processing of rare ores and alluvials. Processing of Ti and Cr ores. Processing of Be and Li ores. Processing of uranium ore. Processing of Ta- Nb ores. Processing of Rare Earth Elements ores.	
	Compulsory or recommended literature: Barry A. Wills, Tim Napier-Munn: Mineral Processing Technology. 2006 Elsevier Science & Technology Books ISBN: 0750644508 SME Handbook of Mineral Processing. Ed.:Weiss, N. L. USA, 1985 ISBN: 0895204436 Periodical SCI Journals, Proceedings of the International Mineral Processing Congresses	

COURSE TITLE: Preparation and production of construction and ceramic materials

	Instructor/ Responsible department/institute: ***Dr Imre Gombkötő PhD,*** ***Associate Professor*** ***Dr Gábor Mucsi PhD,*** ***Associate Professor*** ***Institute of Raw Material Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Mineral based construction materials applied in civil engineering, processing and production technology of construction materials (like concrete and composites) and also raw materials as cement, aggregates or perlite including design of process elements and machinery. The course includes knowledge on physical-chemical properties of the components and also the effect of production to these properties. Complex quality issues and management as well as special issues and trends of the field Non-ceramic type industrial mineral applications (limestone, lime), processing and production including technology and their components. Complex quality issues and management as well as special issues and trends of the field. Links between the product design (targeted product properties) and applied technology are also part of the course. Preparation of raw materials of fine and coarse ceramics (clays, kaolin, volcanic rocks, feldspar, quartz, metakaolin) and additives (comminution, mixing, classification, pressing, heat treatment). Effect of the process engineering parameters of a given apparatus on the characteristics of the middle and final product (fineness, purity). Metakaolin, as a geopolymer raw material. Optimization of the circumstances of glass foam production and its application in the construction industry (heat- and sound insulation material). Utilization of secondary raw materials (waste glass, fly ash, slags, bricks, tiles) in the production and preparation of construction materials and ceramic raw materials. Correlation between process parameters and material characteristics.	
	Compulsory or recommended literature: Industrial minerals and their uses: a handbook and formulary. Edited by Peter A Ciullo., 1996, by Noyes Publications Reuse of Materials and Byproducts in Construction Waste Minimization and Recycling. Edited by Alan Richardson, Springer 2013 Sear, Lindon K.: The Properties and Use of Coal Fly Ash. Thomas Telford, London, UK 2001 Recently published issues of the Journal of Ceramics International, Journal of Cement and Concrete Composites	

COURSE TITLE: Machines and machine systems of process engineering		
	Instructor/ Responsible department/institute: ***Dr József Faitli, PhD*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Main types of machines of comminution and classification. Auxiliary machines (slurry pumps, fans, dust separators, feeders, …) of process engineering. Main aspects of machine selection and sizing for different processing tasks. Examination of dynamical behaviour of revolving and swinging machine parts. Sizing of machine elements based on fatigue. Sizing of bearings for the machines. Examination of wearing caused by the processed granular material. Structural materials for the worn machine elements. Mechanical and hydraulic drives to save machines against overload. Mechanical solutions against dusting: covering, dust extraction, dust separation.	
	Compulsory or recommended literature: Tarján G.: Mineral Processing (Vol. 1, 2). AK. Bp.1981 Höffl K.: Zerkleinerungs- und Klassiermaschinen. SCHLÜTERSCHE Verlagsanstalt und Druckerei GmbH &Co, Hannover, 2006. ISBN 3-9802106-1-8 Böhringer P., Höffl K.: Baustoffe wiederaufbereiten und verwerten. AVS-Institute GmbH – Verlag 8208 Unterhaching, 2008. ISBN 3-9802106-2-7	

COURSE TITLE: Motion of disperse material systems		
	Instructor/ Responsible department/institute: ***Dr József Faitli, PhD*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Rheological behaviour of liquids and suspensions. Measuring the rheological behaviour of fluids. Forces acting on particles. Steady-state and unsteady-state particle motion in Newtonian and in non-Newtonian fluids. Motion of particles put into flowing media, the inertia. Motion of bulk of particles. Flow through porous media. Projectile motion of particles in air. Particle motion in electrostatic, magnetic and centrifugal force fields. Bubble forming and motion in liquids. Droplets forming and motion in liquids and gases.	
	Compulsory or recommended literature: Tarján G.: Mineral Processing (Vol. 1, 2). AK. Bp.1981 Wilson, K. C., Clift, R., Sellgren, A., (2002): Operating points for pipelines carrying concentrated heterogeneous slurries. Powder Technology 123. pp. 19 – 24. Wilson K. C., Horsley R.R., Kealy T., Reizes J.A., Horsley M. (2003): Direct prediction of fall velocities in non-Newtonian materials. Int. J. Miner. Process. 71 pp. 17-30 Wilson, K. C., Sanders, R. S., Gillies, R. G., Shook, C. A., (2010): Verification of the near – wall model for slurry flow. Powder Technology. 197. pp. 247 – 253 Horsley M.R., Horsley R.R., Wilson K.C., Jones R.L.: Non-Newtonian effects on fall velocities of pairs of vertically aligned spheres. J. Non-Newtonian Fluid Mech. 124 (2004) 147-152	

COURSE TITLE: Characterisation of disperse material systems		
	Instructor/ Responsible department/institute: ***Dr Ljudmilla BOKÁNYI PhD, CSc*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other): essay and exam***
	Description*:* Disperse systems. Characterization of coarse disperse systems: degree of dispersion, their phase and textural composition. Main physical properties of the disperse systems. Outlook of the processes aimed at the altering of physical properties. Determination of the size, shape and specific surface of the solid particles. Particle size distribution, distribution functions. Measurement of particle size distribution. Measurement and calculation of specific surface.	
	Compulsory or recommended literature: G Tarján: Mineral Processing I. Akadémiai Kiadó, Budapest, 1981 R.P.King: Modelling and Simulation of Mineral Processing Systems, Butterworth-Heinemann 2001, ISBN:0750648848 Ashok Gupta, Denis Yan: Mineral Processing Design and Operation: An Introduction. Elsevier Science, 2006. ISBN: 0444516360 SME Handbook of Mineral Processing . Ed.:Weiss, N. L. USA, 1985 ISBN: 0895204436 Periodical SCI Journals	

COURSE TITLE: Agglomeration		
	Instructor/ Responsible department/institute: ***Dr. Sándor Nagy, PhD*** ***Lecturer*** **Institute for Raw Material Preparation and Environmental Processing**	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Properties of agglomerates, process engineering characterisation of agglomerate properties. Binding and strength: binding mechanisms and binding forces, theoretical strength of agglomerates. Measurement of fracture-mechanical parameters. Binders and intermediates. Pressure agglomeration: compacting, briquetting, tabletting and its equipment. Describing the extrusion procedures (Johansson correlation). Determination of main technical parameters, scale up models. Applications. Pelletization. Introduction of the process. Main machine types. Description of sintering process, applications.	
	Compulsory or recommended literature: SME Mineral Processing Handbook, Society of Mining Engineering of the American Institute of Mining Metallurgical and Engineers Wolfgang Pietsch: Agglomeration in Industry (Occurrence and Applications), 2005., WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, ISBN 3-527-30582-3 G Tarján: Mineral Processing II., Akadémia kiadó Budapest, 1986	

COURSE TITLE: Basic bioprocessing		
	Instructor/ Responsible department/institute: ***Dr Ljudmilla BOKÁNYI PhD, CSc*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other): essay and exam***
	Description*:* Classification of microorganisms, their structure, built up and metabolism. Population growth and its laws. Limitation factors and inhibitors. Physiological activity. Mutations, adaptation, gen-engineering. Mechanism and kinetics of enzyme-catalysed reactions. Basic phenomena and processing systems of bioleaching (biosolubilisation). Bioaccumulation and biosorption of metal ions: basic phenomena and processing. Application of microorganisms in mining and processing of fossil fuels. Fermentation processes. Biosynthesis. Biodegradation and its application.	
	Compulsory or recommended literature: Brauer, H. (ed.): Biotechnology. ISBN: 0-89573-042-1. Bioprocess Engineering Principles, Second Edition by Pauline M. Doran ISBN-13: 978-0122208515 Bioprocessing for Value-Added Products from Renewable Resources New Technologies and Applications *Edited by:Shang-Tian Yang* ISBN: 978-0-444-52114-2007 Elsevier B.V. Periodical SCI Journals	

COURSE TITLE: Comminution		
	Instructor/ Responsible department/institute: ***Dr Barnabás Csőke, CSC, Dr.habil Professor*** ***Dr Gábor Mucsi PhD, Associate Professor*** ***Dr Ádám Rácz PhD, Researcher*** **Institute of Raw Material Preparation and Environmental Processing**	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description: Material properties, process engineering characterization of the fracture properties. Deformation-fracture. Types of fracture. Criteria, reason of the fracture and explanation by the microstructure: physical fracture theory, crack propagation models. Primary and secondary processes of the energy and material conversion during comminution, physical phenomenon and properties changes by mechanical effect. Work consumption of the comminution, comminution theories (Rittinger, Kick-Kirpicsev, Bond, Beke theories). Efficiency of the comminution. Comminution circuits. Characterization of the comminution result, description of the comminution process, comminution functions and models: matrix and population balance model. Description of the technology, simulation and optimization. Comminution devices. Determination of the main parameters of crushers, mills. Mechanical stresses acting in comminution devices. Grindability of materials.	
	Compulsory literature: Tarján G. (1981): Mineral Processing I-II., Akadémiai kiadó, Budapest Jan Drzymala: Mineral Processing: Foundations of theory and practice of minerallurgy (2007) Wroclaw University of Technology B. A. Wills: Mineral Processing Technology: An Introduction to the Practical Aspects of Ore Treatment and Mineral Recovery (2006) **Recommended literature** Advances in Comminution (Edited by S. Komar Kawatra), (ISBN 978-0-87335-246-8).Society of Mining, Metallurgy, and Exploration, Inc. (SME). Littleton, Colorado, USA, 2005 Juhász A. Z:,- Opoczky L.: Mechanical activation of silicates by fine grinding, Akadémiai Kiadó. Budapest., 1982. Minerals Engineering, International Journal of Mineral Processing, Powder Technology – relevant articles of the last five years	

COURSE TITLE: Model examinations in the mechanical processing		
	Instructor/ Responsible department/institute: ***Dr Barnabás Csőke, CSC, Dr.habil Professor*** ***Dr Ádám Rácz Researcher*** **Institute of Raw Material Preparation and Environmental Processing**	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description: Physical and mathematical model. Model making and model experiments. Modelling of processes: comminution, agglomeration, separation, classification and mixing empirical and semi-empirical, phenomenological functions, models. Scale up models. Typical technologies of the mineral processing: algorithm and material flow determination in one and more step, open and closed circuits processes. Simulation of a Mineral processing technology and its use for the determination of the main technological parameters. Optimization of the mineral processing technologies, optimization methodology and strategy. Case studies.	
	Compulsory literature: Lynch, A.J.: Mineral Crushing and Griding Circuits, Their Simulation, Optimisation Design and Controll, Elsevier, Amsterdam-Oxford-London, 1977 Csőke,B. - Pethő,Sz. - Földesi,J. - Mészáros,L.: Optimatization of Stone-Quarry Technologies. ELSVIER. International Journal of Mineral Processing (ISSN 0-301-7516), 45-46(1996), 447-459 Journal of Mineral Processing (Special Issue Supplement): Comminution 2002. ELSEVIER. Vol.74, 10 December 2004, (ISSN 0301-7516) Csőke, B., Faitli, J., Mucsi, G., Laub, E., Szabó, M.: Modelling of Hydrocone Crushers for Controlling Product Quality. Proceedings of XXIV. International Mineral Processing Congress 2008 (ISBN 978-7-03-022711-9), (Beijing). Volume 2.p.2545-2555 Csőke B.- Mucsi, G.- Solymár, K.: Optimization of Bauxite Grinding by Means Empirical Model. Light Metals 2005, TMS (The Minerals, Metals & Materials Society), Alumina and Bauxite (ISBN Number 0-87339-580-8, ISSN Number 109-9586), Annual Meeting & Exhibition TMS, Februar 13-17 San Francisco, California, USA. (Edited by Halvor Kwande), 2005. p.53-58 **Recommended literature** Advances in Comminution (Edited by S. Komar Kawatra), (ISBN 978-0-87335-246-8).Society of Mining, Metallurgy, and Exploration, Inc. (SME). Littleton, Colorado, USA, 2005 Minerals Engineering, International Journal of Mineral Processing, Powder Technology – relevant articles of the last five years.	

COURSE TITLE: Thermal processing		
	Instructor/ Responsible department/institute: ***Dr Ljudmilla BOKÁNYI PhD, CSc*** ***Associate Professor*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other): essay and exam***
	Description*:* Definition and scope of the thermal processing. Thermodiffuse and high temperature processes. Pyrolysis and gasification of fossil coal. Processes and equipment. Application area. Rectification. Theoretical background, processes and equipment. High temperature reductive processes, their thermodynamic and reaction kinetics aspects. Types, processes and equipment.	
	Compulsory or recommended literature: Bruce Miller: Clean Coal Engineering Technology. Elsiever, 2011.ISBN: 978-1-85617-710-8 Perry's Chemical Engineers Handbook 8th Edition, ISBN 0-07-142294-3 Periodical sci journals	

COURSE TITLE: Modern cements and concretes		
	Instructor/ Responsible department/institute: ***Dr Viktória Gável, Research Engineer*** ***CEMKUT Research&Development Ltd. for Cement Industry*** ***Institute of Raw Materials Preparation and Environmental Processing***	***Credits: 5*** ***Type of Assessment (examination/ practical mark / other):***
	Description*:* Raw materials, production technology and quality requirements of cements and concretes to meet the increasing demands of construction industry and environmental protection. Correlations of parameters of production technology and quality, as well as application properties. Determination of composition and material features of cements to meet special requirements for special application purposes. Development of modern, new-type cements with reduced clinker content and high performance, durable concretes. Optimization of the composition and manufacturing of cements with reduced clinker content (containing high quantity of cement additives) and thereby providing the best properties for the application field to manufacture corrosion resistant concretes. Development of the new type cements with reduced clinker content to manufacture high performance, durable concretes, respectively concretes to meet special quality requirements for example carbonation resistance, freeze-thaw resistance. Importance of environmental friendly cements with reduced clinker content (reducing CO_2-emission, utilization of secondary raw materials and fuels etc.) in the decreasing global warming: direct and indirect effects. Composition and manufacturing of cements and concretes with advantageous properties from ecological point of view. Utilization of secondary raw materials and industrial by-products in the cement and concrete production.	
	Compulsory or recommended literature: *H*.F.W. Taylor: Cement Chemistry, 2nd edition, Thomas Telford Publishing, London, 1997 (ISBN: 0 7277 2592 0) VDZ Congress 2013: Process Technology of Cement Manufacturing, Verlag Bau+Technik GmbH, Duesseldorf, 2013 (ISBN: 978-3-7640-0583-2) S. N. Ghosh: Advances in Cement Technology: Chemistry, Manufacturing and Testing, 2nd edition, Tech Books International, New Delhi, 2002 (ISBN: 81-88305-04-9) Periodical SCI Journals, Proceedings	

Course title: Hydraulic and pneumatic power transport

	Responsible: **Dr. Ladányi Gábor PhD, associate prof.** ***Institute for Mining and Geotechnical Equipment***	***Credits: 5*** ***Pre-requisites:***
	Course description: *Fluid power, hydrostatic and hydro-kinetic power. Theoretical basics of hydro-dynamic power transport. Structure, operation and special curves of hydro-dynamic clutch. Constant and variable loaded clutch.* *Theoretical basics of hydrostatic and pneumatic energy transport. Hydraulic fluids. Hydraulic pumps. Hydraulic motors. Directional control valves, check valves, pressure control valves, flow control valves. Accessories. Filters and filtration technology. Containers.* *Energy content of compressed air. Compressors (reciprocating, turbo), motors.* *Elements of a pneumatic system. Different valves. Auxiliary elements: containers, water separators. Analysis of pressure drop and energy losing.*	
	Literature: Rexroth : Hydraulics, Basic Principles and Components (Publisher: Bosch Rexroth AG)	

Course title: Acoustical measurement regarding operation of process machines		
	Responsible: **Dr. Ladányi Gábor PhD, associate prof.** ***Institute for Mining and Geotechnical Equipment***	***Credits: 5*** ***Pre-requisites:***
	Course description: *Basic devices of acoustic measurements. Elements of signal processing. Parameters of noise qualification. Basics of processing of sampled signal. Data acquisition about machine by acoustical measurement. Measuring results are suitable for making decision about condition of machine. (different spectrums, amplitude distribution) Identification of parameters are specific by the machine and by the condition of machine.*	
	Literature: Brüel & Kjaer: Acoustic noise measurements Brüel & Kjaer: Mechanical vibration and shock measurement J.Blauert, N.Xiang: Acoustics for engineers	