Petroleum Geoengineering MSc
University of Miskolc, Faculty of Earth Science and Engineering

Syllabus

Courses		Page
Basic Courses		
1. Structural geology		2.
2. Stratigraphy		3.
3. Sedimentology of carbonate reservoirs		4.
4. Introduction to applied geophysics		5.
5. Introduction to petrophysics		6.
6. Applied petrology.		7.
Basic Professional Courses		
1. Wellsite geology		8.
2.Geostatistics		9.
3. Drilling engineering, HSE		10.
4. Basin modeling.		11.
5. Exploration seismic techniques and interpretation		13.
6. Petrophysics - Well log interpretation		14.
7. Exploration geochemistry of hydrocarbons		15.
8. Oilfield chemistry		16.
9. Oilfield hydrogeology		17.
Special Professional Courses		
1. Fluid mechanics and flow in porous media, transport modeling		18.
2. Core analysis		20.
3. Sedimentology of clastic reservoirs		21.
4. Estimation of resources/reserves		22.
5. Petroleum economics		23.
6. Analysis of petroleum systems, prospect evaluation		25.
7. Reservoir geology and modeling		26.
8. In-field seismic techniques and interpretation		28.
9. Reservoir engineering		29.
10. Planning, implementing and managing E&P projects		30.
11. Project work		31.
12. Research- or exploration-based thesis work		33.
Elective Courses		
1. Introduction to geophysical literature (Optional Courses I.)		34.
2. Gradual research seminar (Optional Courses I.)		35.
3. X-ray diffraction applications for petroleum geology (Optional Courses II.)		36.
4. Basic data processing methods for oilfield geophysics and petrophysics (Optional Courses II.)		37.

Course Title: Structural geology	**Credits: 3**

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

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

Exercise: solving a construction problem in connection with a case study, using the tools and software introduced during the course.

Grading Limits:
>80%: excellent,
70-79.9%: good,
60-69.9%: medium,
50-59.9%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:The course provides a background in the fundamentals of structural geology in the context of petroleum exploration and production. It introduces the methods of interpreting structural observations and determining the 3-D distribution of the lithological units, the physical properties controlling the development of fractures, folds and other structural features. The course also introduces the students to building up, constructing and analysing spatial models.
Course content:Theoretical backgrounds: basic terms of structural geology and tectonics. Techniques of data acquisition, recording and visualization. Stress and strain, deformation mechanisms, rheological models. Brittle and ductile features, their style and origin. Syngenetic structures and their role in further structural evolution. Plate tectonics and large scale structures. Characteristics of tectonic regimes. Practical exercises: use of tools to measure, demonstrate and analyze the structural data. Basics for constructing maps and cross sections.
Education method:Lectures with presentation slides, construction and calculation exercises on sheets and with computer.

Competencies to evolve:

- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to explore hydrocarbon-bearing geological structures in a workmanlike manner and to plan the exploitation process.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Ramsay, J. G. & Huber, M. I: The techniques of modern structural geology. Vol. 1: Strain Analysis. *Academic Press, London, 1983*, 1-308 p.
- Ramsay, J. G. & Huber, M. I: The techniques of modern structural geology. Vol. 2: Folds and Fractures. *Academic Press, London, 1987*, 309-700 p.
- Ramsay, J. G. & Lisle, R. J: The techniques of modern structural geology. Vol. 3: Applications of continuum mechanics in structural geology. *Academic Press, London, 2000*, 701-1062 p.
- Twiss, R. J. & Moores, E. M: Structural Geology. *Freeman & Co., New York, 1992*, 532 p.
- Twiss, R. J. & Moores, E. M: Tectonics. *Freeman & Co., New York, 1995*, 415 p.

Responsible Instructor(*name, position, scientific degree*)**:**

Norbert Németh Dr., assistant professor, PhD

Course Title: Stratigraphy	**Credits: 3**

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

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

one field and one cameral exercise each. The field exercise is to be presented in groups, in ppt-format and orally based on one of the two field surveys during the semester. The indoor exercise is the complex evaluation of a geological map with special attention to unconformities and characterization of the sequences of geological cycles between them. These exercises give 40%, while the exam gives other 60% of the grade of the course.

Grading limits:
>90%: excellent,
75-90%: good,
60-75%: medium,
45-60%: satisfactory,
<45%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:The student will learn how to use stratigraphy (including stratigraphic contradictions) in petroleum geology as basic information for structural modelling.
Course content:Principles of stratigraphy. Types of bedding. Relationship between different rock bodies. Unconformity types. Age-determination of rocks. Stratigraphical correlation: fundamentals of bio-, litho-, chemo-, cyclo-, magneto-, seismo-, chrono- and sequence stratigraphy. Geological time scale and stratotypes. Basin analysis: synthesis of different stratigraphic and other methods; its role in petroleum exploration and production with case studies. Stratigraphy and evolution of Hungarian basins.
Education method:Lectures with powerpoint presentation, cameral evaluation of a geological map with the construction of a geological cross-section, two field surveys, one day each.

Competencies to evolve:

- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Brookfield, M. (2006): Principles of Stratigraphy. 340 p., Blackwell Publishing, ISBN 1-4051-1164-X.
- Boggs S. Jr. (2006): Principles of sedimentology and stratigraphy. 4th Edition. 662 p., Pearson Prentice Hall, ISBN: 0131547283.
- Allen P. A & Allen J.R. (2013): Basin Analysis. Principles and Application to Petroleum Play Assessment. 3rd. Edition, 642 p., Wiley & Sons, ISBN 978-0-470-67377-5.
- Veeken P.P. (2007): Seismic Stratigraphy, Basin Analysis and Reservoir Characterisation.Handbook of Geophysical Exploration: Seismic Exploration. **37**, 523 p., Elsevier, ISBN: 0080453112.
- Haas J. (ed., 2013): Geology of Hungary. Regional Geology Reviews. 244 p., Springer, ISBN: 978-3-642-21909-2.

Responsible Instructor(*name, position, scientific degree):*

György Less Dr., professor, DSc

Course Title: Sedimentology of carbonate reservoirs	**Credits: 3**

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

Type of Assessment (exam. / pr. mark. / other):**exam**
During the semester 2 written examinations will be written, if both is insuffitient, then there is a possibility for oral exam. Only one unjustified lecture/practice is tolerated.
Grading limits:
> 80%: excellent,
70-80%: good,
60-70%: fair,
50-60%: sufficient,
<50%: insufficient.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:To understand the carbonate reservoirs: the geometry and the petrophysical characteristics of carbonate reservoirs. To understand the main control factors influencing the formation of carbonate reservoirs: (1) sedimentology, (2) diagenesis (3) burial history.
Course content:Introduction to carbonate rocks and reservoirs. Carbonate vs. siliciclastic sediments, and reservoirs. Mineralogy of carbonate rocks. Controls on carbonate production and accumulation. Fundamental rock properties: texture, fabric, composition, sedimentary structures. Classification of carbonate rocks. Porosity and permeability in carbonate rocks. Petrophysical properties of carbonate reservoirs: saturation, wettability, capillarity. Capillary pressure and reservoir performance. Capillary pressure, pores and pore throats. Carbonate depositional environments (beach-dune, tidal-flat, lagoon, shallow subtidal (neritic), slope-break, slope environment, basinal environments) and reservoirs. Depositional porosity. Paleotopography and depositional facies. Diagenetic carbonate reservoirs. Diagenesis and diagenetic processes. Diagenetic environments and facies. Diagenetic porosity. Diagnosing and mapping diagenetic reservoirs. Fractured reservoirs. Carbonate sequence stratigraphy and cyclicity. Relationship of primary depositional facies, sequence stratigraphic framework and diagenetic history to pore architecture and reservoir quality. Sequence sratigraphy in exploration and development.
Eduction method:Lectures with powerpoint presentation, field practice consisting of two parts: 1. visiting carbonate outcrops, representing a wide range of carbonate facies, 2. practical workshop in the MOL redepository core house in Szolnok.
Competencies to evolve:
- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Ahr Wayne M. (2008): Geology of Carbonate Reservoirs. Wiley Publication. 1-273.
- Lucia F. Jerry (1999): Carbonate Reservoir Characterization. Springer. 1-226.
- Scholle P. A., Bebout D.G., Moore C.H. ed. (1983): Carbonate Depositional Environments. AAPG Memoir 33. 1-704.
- Tucker M. (2003): Sedimentary Rocks in the Filed. Wiley.1-234.
- Stow D.A.V. (2010): Sedimentary Rocks in the Filed. Manson Publishing. 1-320.

Responsible Instructor(*name, position, scientific degree):*

Velledits Felicitasz Dr., Phd, part-time associate professor

Course Title: Introduction to applied geophysics	**Credits: 3**

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

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

In the course of the practical lessons there are individual problem solutions and assignments. Field practice is also planned. Assigments have 30%, final exam has 70 % in the grade weithing.

Grading limits:
> 80%: excellent,
70-80%: good,
60-69%: satisfactory,
50-59%: pass,
< 50%: fail.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:Introduction to applied geophysical methods and their basic interpretation with special emphasis on geophyisal exploration and well logging used in HC exploration.
Course content:Introduction, general overview and classification of geophysical techniques used in oil and gas industry. Role of geophysical related information in oil and gas reservoir lifecycle, and in oil and gas business decisions. Lifecycle of reservoirs in O&G industry, main business decision points, role of geotechnical information in business decisions. Exploration geophysical methods with low resolution (gravity, magnetic, radiometry, geothermal surveys). Electromagnetic methods in oil&gas industry. Seismic exploration methods (bases of elastic wave propagation; vertical and horizontal resolution; corrections, migration, time-depth conversion; VSP; bright spot and AVO classes). Basic principles and practice of borehole geophysics. Important well logs of open and cased hole applied in petroleum industry. Technical, geological, geophysical, production information gained by well logging.
Special laboratory and field exercises contribute to the efficiency of this course.
Eduction method:Presentations using PC and projector, laboratory and field exercises, assignments about the exercises.

Competencies to evolve:

- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to explore hydrocarbon-bearing geological structures in a workmanlike manner and to plan the exploitation process.
- Ability to plan the surface and well-logging geophysical investigations, to make and control measurements, to process and evaluate the measurement data, to make geological and geophysical interpretation, to review these operations.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Gadallah M., Fisher R., 2009: Exploration Geophysics, Spinger-Verlag.
- Kearey P., Brooks M., Hill I., 2002: An Introduction to Geophysical Exploration, Blackwell Publishing.
- Bacon M., Simm R., Redshaw T., 2007: 3-D Seismic Interpretation, Cambridge University Press.
- Serra O., 2007: Well Logging and Reservoir Evaluation, Technip.
- Telford W. M., Geldart L. P., Sheriff R. E., 1990: Applied Geophysics. 2nd Edition. Cambridge University Press.

Responsible Instructor(*name, position, scientific degree):*
Gábor Pethő Dr., research fellow, PhD

Course Title: Introduction to petrophysics	**Credits: 3**

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

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

Attendence at lectures is regulated by the university code of education and examination. Writing two tests during the term and making one powerpoint presentation on an assigned topic (condition of signature).

Grading limits:
> 86%: excellent,
71-85%: good,
51-70%: medium,
41-50%: satisfactory,
< 40%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:The topic provides rock physical basis for petroleum applications and the theory and practice of wireline logging measurements.
Course content:Petrophysical properties of rocks. Electromagnetic, seismic, acoustic wave propagation in rocks. Rock mechanical studies, velocity versus pressure relationships. Rock physical models (Hooke, Kelvin-Voight, combined models). The borehole and its environment. Petrophysical modeling of formations. Physical principles of well-logging methods. Open-hole wireline logging methods: lithologic (natural gamma ray intensity, spectral gamma ray, spontaneous potential), porosity (neutron-neutron, gamma-gamma, acoustic) and saturation (laterolog and induction-based resistivity) logs. Corrections of open-hole logs for rock composition, fluid content, shaliness. The nuclear magnetic resonance log, EM wave propagation logging. Resistivity and acoustic methods for borehole imaging. Open-hole technical measurements. Production well-logging measurements in cased holes. Field studies and applications.
Eduction method:
Competencies to evolve:

- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Knowledge of exploration methods of oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to explore hydrocarbon-bearing geological structures in a workmanlike manner and to plan the exploitation process.
- Ability to plan the surface and well-logging geophysical investigations, to make and control measurements, to process and evaluate the measurement data, to make geological and geophysical interpretation, to review these operations.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Mavko G, Mukerji T, Dvorkin J, 2009: The Rock Physics Handbook, 2nd edition, Cambridge Univ. Press.
- Serra O, 1984. Fundamentals of Well-Log Interpretation. Elsevier, Amsterdam.

- Ellis D V, Singer J M: Well logging for earth scientists. Springer, 2007.

Responsible Instructor(*name, position, scientific degree):*
Mihály Dobróka Dr., professor, DSc

Course Title: Applied petrology	**Credits: 3**

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

Type of Assessment (exam. / pr. mark. / other):**exam**
Two exercises and their reports have to be made during the semester, which are based on complex instrumental evaluation of rock samples as self-sufficient tasks. These exercises return the 40% of the grade at the end of the semester. The other 60% can be acquired at the written examination at the end of semester.
Grading limits:
> 80%: excellent,
70-80%: good,
60-70%: medium,
50-60%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals: Indepth introduction to texture analysis of different rock types with special emphasis on reservoir properties of porous and fractured rocks, using different analytical techniques.
Course content:Analytical techniques used in petrographic research - optical microscopy, XRPD, cathod luminescece microscopy, electron microprobe analysis, digital image analysis. Main rock forming minerals and their identification with different analytical techniques. Definition of rock texture, texture elements in different rock types. Magmatic and metamorphic rocks – compositional and texture types, classification systems. Deformation of crystalline rocks, main deformation mechanisms. Deformational texture elements. Fractured reservoirs - types (fracture or reservoir); fracture appearance in different scales (micro, macro, mega); matrix block (fracture density) and idealized modelling; importance of orientation. Alteration of rocks, alteration textures. Clastic sedimentary rocks - compositional and texture types, texture elements, system of classification. Carbonate rocks - compositional and texture types, texture elements, system of classification. Pore and pore geometry – origin of pores, scale of pore geometry. Pore types (siliciklastic, carbonate), (macro-micro) descriptions, porosity, permeability properties. Capillary pressure - seal capacity; saturations (S_w, S_o, S_g) with depth; transitional zone thickness; recovery efficiency. Main differences between matrix porosity and fractured reservoir properties.
Education method:Lectures with ppt presentation, laboratory excercises in optical microscopy, XRPD, electron microscopy, digital image analysis, field excerxise.
Competencies to evolve:
- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Folk R.L. Petrology of sedimentary rocks, Hemphill Publ. Co., 1980.

- Scholle P.A. & Ulmer-Scholle D.S.: A Color Guide to the Petrography of Carbonate Rocks: Grains, textures, porosity, diagenesis (AAPG Memoir 77; AAPG Tusla, Oklahoma, 2003).
- Adams A.E.; Mackenzie W.S.; Guilford C.: Atlas of sedimentary rocks under the microscope
- J. Pápay, 2003: Development of Petroleum Reservoirs, Akadémiai K., Budapest 2003.
- M. D. Zoback, 2007: Reservoir Geomechanics, Cambridge UP.
- T.D. Van Golf-Racht, 1982: Fundamentals of Fractured Reservoir Engineering, Elsevier S. P. C., 1982. Development Geology (Jegyzet, 2003, HOT Engineering & Shell Iran Offshore B.V.).
- R.F. Aguilera, 1980, 1995: Naturally Fractured Reservoirs, PennWell Books, Tulsa.

Responsible Instructor(*név, beosztás, tud. fokozat*)**:**

Ferenc Mádai Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):
Norbert Zajzon Dr., associate researcher, PhD
Ferenc Kristály Dr., research engineer, PhD
Kiss Balázs Dr. (MOL Group)
Zoltán Bíró Dr. (MOL Group)

Course Title: Wellsite geology	**Credits: 3**

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

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

Exercise: solving a task in a virtual drilling programme using the tools and software introduced during the course.

Grading limits:
>80%: excellent,
70-79.9%: good,
60-69.9%: medium,
50-59.9%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:

Study goals:The topic introduces the tasks and roles of a wellsitegeologist during drilling, well-test and production operations in cooperation with the drilling supervisor, the rig personnel, subcontractors and the company's office. It provides an integrated knowledge base how to control, evaluate and document the respective data from the geological point of view and assists to the operative decision makers. Up-to-date tools and equipment sets assisting the geologists are shown.

Course content:Preparing a well-logging programme; tools for sampling, evaluating, describing and analyzing the formations; records and reports; decision points during drilling; log types, wireline logging and logging while drilling; temperature, caliper, resistivity, self potential, gamma ray, neutron, sonic and acoustic logs and the uses of these; mud-logging; log interpretation; coring technologies, working with cuttings and core samples; drilling hazards and drilling bit optimization; integration with seismic and sequence stratigraphy.

Education method:Lectures with presentation slides, exercises on sheets and with computer.

Competencies to evolve:

- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Knowledge of exploration methods of oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Asquith, G. B; Gibson, C. R: Basic well log analysis for geologists. American Association of Petroleum Geologists, 1982, 216 p.
- Chapman, R: Petroleum geology. Elsevier Science, 1983, 415 p.
- Darling, Toby: Well logging and formation evaluation. Elsevier, Gulf Professional Publishing, 2005, 326 p.
- Ellis, Darwin V; Singer, Julian M: Well logging for earth scientists. Springer, 2007, 692 p.
- Rider, M: The geological interpretation of well logs. Rider-French Consulting, Sutherland, 2002, 280 p.

Responsible Instructor(*name, position, scientific degree):*

Norbert Németh Dr., associate professor, PhD

Course Title: Geostatistics	**Credits: 3**

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

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

Attendence at lectures is regulated by the university code of education and examination. Writingtwo tests during the term and making one powerpoint presentation on an assigned topic (condition of signature).

Grading limits:

> 86%: excellent,
71-85%: good,
61-70%: medium,
46-60%: satisfactory,
<45%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:

Study goals:The topic provides an introduction to the principles and hydrocarbon applications of mathematical statistical methods, and equips the students with necessary skills to apply statistical methods in building both deterministic and stochastic reservoir models.

Course content:Gaussian and non-Gaussian data distributions, most frequent value estimation, linear and rank correlation between variables, linear and non-linear regression analysis, spatial correlation of geoparameters, variogram models and kriging, multidimensional scaling and modeling, hierarchical and non-hierarchical cluster analysis, principal component analysis, factor analysis and its applications in geosciences, linear and global optimization methods and their statistical relevances (estimation errors, correlation of model parameters), fuzzy logic, theory of neural networks.

Education method:Lectures by means of MS-powerpoint presentations. The application of Mathworks MATLAB Statistical Toolbox. Statistical computations presented byMATLAB programs developed at the Department of Geophysics.

Competencies to evolve:

- Experiencing complex engineering and economic processes by integrating the geological and geophysical exploration works and by joining with the quality management system.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Edward H. Isaacs, R. Mohan Srivastava, 1989. An introduction to applied geostatistics. Oxford University Press.
- Troyan V, Kiselev J, 2010: Statistical methods of geophysical data processing. World Scientific Publishing Co.
- Reyment R A, Jöreskog K G, 1996:Applied factor analysis in the natural sciences. Cambridge Univ. Press.

Responsible Instructor(*name, position, scientific degree):*

Norbert Péter Szabó Dr., associate professor, PhD

Course Title: Drilling engineering, HSE	**Credits: 4**

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

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

In the frame of this course the students have to make two reports about their own work on lab practice or design work. The reports will be weighted up to 40 % in the final mark; the other 60 % will be given according to written test at the end of the semester.

Grading limits:

>80%: excellent,
70-80%: good,
60-70%: satisfactory,
50-60%: pass,
<50%: fail.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:

Study goals:Complex introduction of the drilling technology and well completion.

Course content:The main subjects of the curriculum: introduction of the drilling rig components, the drilling process. Drill string design, drill bits properties. Drilling mud. Vertical and directional drilling techniques. Casing design. Wellbore stability. Casing cementing design. Managed pressure drilling technology.Elements of well costing and affecting for well costing. Drilling time estimate. Drilling risk estimates. Unscheduled event during drilling operation. Tubing string design, introduction of packer types, well completion tools selection. Perforating techniques, control the formation damage. Well completion fluids, gravel pack techniques, formation stimulation, well completion quality control.

Education method: lectures with ppt presentation, laboratory measuring, design exercises, presentation with using drilling simulator.

Competencies to evolve:

- Knowledge of exploration methods of oil and natural gas resources.
- Knowledge of exploitation methods of oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to explore hydrocarbon-bearing geological structures in a workmanlike manner and to plan the exploitation process.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- H. Rabia: Oilwell Drilling Engineering. Principles and Practice. Graham Tratman Ltd. London 1995. 322 p.
- Howard B. Bradley: Petroleum Engineering Handbook, Third Printing, Society of Petroleum Engineers, Richardson, TX, U.S. A. 1992.
- Drilling Data Handbook, Edition Technip, Paris ISBN 2-2108-0756-4, 1999. 542 p.

Responsible Instructor(*name, position, scientific degree):*
Tibor Szabó Dr., associate professor, PhD

Course Title: Basin modeling	**Credits: 4**

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

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

Exercise: solving a task in basin modelling process using the tools and software introduced during the course.

Grading limits:
>80%: excellent,
70-79.9%: good,
60-69.9%: medium,
50-59.9%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:The course covers the fundamentals of petroleum systems analysis and its use in hydrocarbon exploration. The topic includes concepts and examples of petroleum systems, petroleum source rocks, modelling of petroleum systems, and an introduction to basin-scale pressures and fluid dynamics. Practical examples in using the quantitative tools and techniques in modeling petroleum systems of a basin (i.e. the formation, generation, migration and trapping of hydrocarbons) are provided. At the end of the topic, students are able to undertake 1-D basin modelling using industry-standard software, and are aware of the extension of this process into 2-D and 3-D applications. Examples from different basin types are used to illustrate the petroleum systems concept.
Course content:Basic principles of sedimentology (grain size, bedding, transport capacity, sedimentation rate and preservation potential). The main types of basins, and their most important features. The geodynamical characterization and geothermic properties of the main basin types. The tectonic and paleoenvironmental recontstruction. Facies models in siliciclastic marine and fluvial systems. Facies

analysis in outcrops, cores and wireline logs. Concept and way of high resolution facies correlation on wireline logs in marine successions: „parasequences", sets of „parasequences", correlative surfaces like flooding surface (FS), maximum flooding surface (MFS). The sequence stratigraphic approach: the accommodation concept, systems tracts (Lowstand, Transgressive, Highstand and Falling Stage Systems Tract), the problems of the sequence boundary (SB). Sequences on wireline logs and seismic profiles (migrated time sections). Problems and possibilities of terrestrial (fluvial) sequences. Carbonate depositional environments, analogies and differences. Variations in sequence evolution in response to the relative sea level changes (eustatic, tectonic and climatic controls) and to the basin structure development. 2-D, 3-D and 4-D problems and solutions in basin analysis.Practical course: Method of facies description/documentation on outcrops (Diósgyőr sand pit). Handling and facies interpretation of log data. Appearance of sedimentary features on cores and wireline logs (Geokomplex Ltd. - Miskolc). Log facies analysis and log correlations in datum- and sea-level-projected circumstances. Relation of wireline logs and seismic data in sequence stratigraphic context, joint interpretation of log facies and seismic horizons. Sequence stratigraphic interpretations of seismic sections and log correlations. Identifications of structural elements on seismic sections from the aspect of sequence development.
Education method:Lectures with presentation slides, exercises on sheets and with computer.

Competencies to evolve:

- Experiencing complex engineering and economic processes by integrating the geological and geophysical exploration works and by joining with the quality management system.
- Ability to enumerate the hydrocarbon resource qualitatively and quantitatively and make economic evaluation, to compile license materials, to review the related reports.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Bridge, J.S. 2003, Rivers and Floodplains, Blackwell Publishing p. 491.
- Magyar I. 2010, A Pannon-medence ősföldrajza és környezeti viszonyai a késő miocénben. – GeoLitera, Szeged, p. 139.
- Posamentier H.W., Allen G.P. 1999, Siliciclastic Sequence Stratigraphy – Concepts and Applications – SEPM No. 7 204 p.
- Püspöki, Z. Torma, B. (eds.) (2010): Fluvial sediments in cores and geophysical well-logs. – Dominium Publisher, p. 327.
- Van Wagoner, J.C., Mitchum, R.M.Jr., Campion, K.M., Rahmanian, V.D. 1990, Siliciclastic sequence stratigraphy in well logs, core and outcrops: concepts for high-resolution correlation of time and facies. AAPG Methods in Exploration Series, v. 7, p. 55.

Responsible Instructor(*name, position, scientific degree):*

Norbert Németh Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Katalin Milota Dr., PhD (MOL Group)

Zoltán Püspöki Dr., PhD (Geological and Geophysical Institute of Hungary)

Course Title: Exploration seismic techniques and interpretation	**Credits: 4**

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

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

Attendence at lectures is regulated by the university code of education and examination. Writing two tests during the term and making one powerpoint presentation on an assigned topic (condition of signature).

Grading limits:
>86%: excellent,
71-85%: good,
56-70%: satisfactory,
46-55%: pass,
<45%: fail.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:

Study goals:The course provides an integrated introduction to the acquisition, processing and interpretation of 2-D and 3-D seismic data sets. The topic has a particularly strong practical emphasis, with many sessions conducted on an industry-standard computer workstation network.

Course content:From planning phase of seismic data acquisition, state-of the art acquisition methods, up-to-date recording systems (cable and wireless systems), applicable seismic source types (vibroseis, impulse) and source related noises will be overviewed. Basic data processing steps will be discussed with their effects to data quality improvement and signal to noise ratio enhancement. Typical 2-D and 3-D data processing flows will be provided. Fundamentals of interpreting (correlation, sequence stratigraphy, 3-D visualization, amplitude studies, AVO, time sections, depth conversions, depth sections) will be discussed and demonstrated. Hands-on experience of interpreting 2-D and 3-D seismic datasets from a variety of structural and stratigraphic settings will be provided.

Education method:

Competencies to evolve:

- Experiencing complex engineering and economic processes by integrating the geological and geophysical exploration works and by joining with the quality management system.
- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to plan the surface and well-logging geophysical investigations, to make and control measurements, to process and evaluate the measurement data, to make geological and geophysical interpretation, to review these operations.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- W. Ashcroft, 2011: A Petroleum Geologist's Guide to Seismic Reflection.
- Öz Yilmaz, 2001: Seismic Data Analysis: Processing, Inversion, and Interpretation.
- M. Bacon, R. Simm, T. Redshaw, 2003: 3-D Seismic Interpretation.

Responsible Instructor(*name, position, scientific degree):*

Mihály Dobróka Dr., professor, DSc

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

László Gombár Dr. (Geoseis Consulting Deposit Company)
István Sebe (MOL Group)

Course Title: Petrophysics - Well log interpretation	**Credits: 4**

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

Type of Assessment (exam. / pr. mark. / other):**exam**
Attendence at lectures is regulated by the university code of education and examination. Writing two tests during the term and making one powerpoint presentation on an assigned topic (condition of signature). Solving two practical exercises on well log analysis and presenting the results in WellCAD or other industry-used system.
Grading limits:
>86%: excellent,
71-85%: good,
56-70%: satisfactory,
46-55%: pass,
<45%: fail.

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

Pre-requisites *(if any)*:**Introduction to petrophysics**

Course Description:

Acquired store of learning:
Study goals:The course gives detailed information on well-logging techniques used in oil and gas industry.
Course content:The fundamentals of open and cased hole log analysis. Data processing (corrections) and deterministic, statistical, inversion methods based interpretation methods. Estimation of shale volume, porosity, matrix composition, water and hydrocarbon saturation, permeability, elastic parameters. Crossplot techniques for porosity and lithology definition. Comparing the interpretation results with core measurements. Calculation of hydrocarbon reserves. Special measurement types. Pore size distribution based on nuclear magnetic resonance logs. Processing of image logs. Well-to-well correlation. Interpretation of production well logs (cement evaluation, production and injection profiles, detecting fluid-flow behind the casing, reservoir monitoring).
Education methods:Lectures by means of MS-powerpoint presentations. Solving well log analysis problems with deterministic/inversion-based methods by means of industry-used systems.
Competencies to evolve:

- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Knowledge of exploration methods of oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to plan the surface and well-logging geophysical investigations, to make and control measurements, to process and evaluate the measurement data, to make geological and geophysical interpretation, to review these operations.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.

- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Asquith G, Krygowski D (2004) Basic well log analysis, 2nd edn., AAPG, Tulsa.
- Rider M, 2002: The geological interpretation of well logs. Rider-French Consulting, Sutherland.
- Schlumberger, 1989: Log interpretation principles / applications. Texas.
- Ed. L. Bigelow, 2002: Introduction to Wireline Log Analysis Baker Atlas.
- O. & L. Serra, 2004: Well Logging Data Acquisition and Applications, Serra Log.

Responsible Instructor(*name, position, scientific degree):*

Norbert Péter Szabó Dr., associate professor, PhD

Course Title: Explorationgeochemistry of hydrocarbons	**Credits: 3**

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

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

Writing of two scientific essays during the semester on the level of pass grading limit, at least. This equals to 40% of the requirements. The remaining 60% is procurable in the exam.

Grading limits:
>80%: excellent,
70-80%: good,
60-70%: satisfactory,
50-60%: pass,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:

Study goals:Fundamentals of organic geochemistry are discussed as a factor controlling the generation, deposition, accumulation of organic carbon as a source of the petroleum. Inorganic geochemistry as a tool of understanding the reservoir rock cementation. 3-D heterogeneity of reservoir rocks as a result of differential cementation.All these are connected to designing and implementing well stimulation operations. Fingerprint methods to correlate source rocks with discovered petroleum fluids and identification of migration path are introduced.

Course content:Natural systems and their classification, rocks, water, organic matter, and gases as a specific natural system. Systems approach in petroleum geology. Oil and gas-bearing rocks. Temperature and pressure in the subsurface. Water. Crude oils. Natural gases and condensates. Dispersed organic matter. Origin of oil and natural gas. Formation of hydrocarbon accumulations. Classifications of oil and gas accumulations. Mathematical modeling in petroleum geology.

Practices: Inorganic geochemistry applied to petroleum geology, overview. Textural and mineralogical analysis. Fluid inclusions. Stable isotopes. Radiogenic isotopes. Porosity and permeability prediction. Fluid migration. Correlation. Petroleum recovery. Oil fingerprinting for production allocation.

Education method: Lectures with ppt presentation, laboratory exercises in optical microscopy, XRPD, electron microscopy, digital image analysis, field exercise.

Competencies to evolve:

- Knowledge of exploration methods of oil and natural gas resources.

- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to enumerate the hydrocarbon resource qualitatively and quantitatively and make economic evaluation, to compile license materials, to review the related reports.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.Demand for continual renewal of technical skills.

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

- G.V. Chilingar, L.A. Buryakovsky, N.A. Eremenko & M.V. Gorfunkel: Geology and geochemistry of oil and gas, DEVELOPMENTS IN PETROLEUM SCIENCE vol: 52, Elsevier 2005.
- Dominic Emery & Andrew Robinson: Inorganic Geochemistry, Applications to Petroleum Geology, OXFORD, BLACKWELL SCIENTIFIC PUBLICATIONS, 1993.
- Barry Bennett, Jennifer J. Adams, Stephen R. Larter: Oil Fingerprinting for Production Allocation: Exploiting the Natural Variations in Fluid Properties Encountered in Heavy Oil and Oil Sand Reservoirs, Frontiers + Innovation – 2009 CSPG CSEG CWLS Convention, Calgary Alberta, Canada, pp: 157-160.

Responsible Instructor(*name, position, scientific degree):*
Viktor Mádai Dr., assistant professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):
Katalin Milota Dr., PhD (MOL Group)
Mária Vidó Dr. Hámor Dr.

Course Title: Oilfield chemistry	**Credits: 3**

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

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

Grading limits:
>%: excellent,
%: good,
%: satisfactory,
%: pass,
<%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:
Course content:Fundamentals of physical chemistry and colloid chemistry: behavior of real gases, equilibria, reaction kinetics, sorption phenomena, rheology, diffusion, colloid systems, surface and interfacial tension,capillary forces, wettability, properties of suspensions and emulsions. Chemistry of drilling muds andwell completion fluids. Chemical well stimulation methods including hydraulic fracturing, acidization,profile control in water injection wells, chemical methods providing selective fluid flow in oil and gasproducing wells (water shutoff treatments and GOR improving techniques). Fundamentals of intensiveflooding technologies addressing the whole reservoir space. Chemical aspects of improved and enhancedoil and gas productions methods (IOR/EOR and IGR/EGR), including the thermal, gas injection andchemical (alkaline, surfactant and polymer) technologies. Mitigation of formation damage by chemicals,bottomhole clean-up for paraffin, asphaltene deposits, and chemical sand control in wells. Basics ofwater technology: composition of formation waters, mechanism of scale

formation, their inhibition andremoval of inorganic scales by chemicals. Surface and underground corrosion of metallic structures,types and origin of corrosion, corrosion inhibitors. Hydrocarbon hydrates and inhibition of hydrateformation at well site and transport pipelines.
Education method:

Competencies to evolve:

- Knowledge of exploration methods of oil and natural gas resources.
- Knowledge of exploitation methods of oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to enumerate the hydrocarbon resource qualitatively and quantitatively and make economic evaluation, to compile license materials, to review the related reports.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

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

Responsible Instructor(*name, position, scientific degree):*
István Lakatos Dr., professor, DSc (member of the Hungarian Academy of Sciences)

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):
István Papp (MOL Group)

Course Title: Oilfield hydrogeology	**Credits: 3**

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

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

During the semester one written test and 5 exercises are given. The former is responsible for the 30% of the mark, while the latter ones contributeto the 70% of that.

Grading limits:
> 90%: excellent,
75-89 %: good,
65-74%: satisfactory,
51-64%: pass,
< 50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:The students will be familiar with the main concepts of modern hydrogeology as well as petroleum or oilfield hydrogeology. The students will review the migration and accumulation theories and will understand the hydrogeologic indicators of petroleum reservoirs. The students will be able to apply hydrogeology in regional petroleum and gas exploration projects. The course makes the students understand the presence and place of hydrocarbon-pools.
Course content:The main properties and quality aspects of groundwater. Classification of groundwater resources. Storage and hydraulic properties. Darcy-law, flow and seepage equations. Temperature properties under the surface. Shallow and deep groundwater. Flow systems under the surface. Groundwater as a geologic agent. Determination of hydraulic conductivity. Transport processes in groundwater. Basics of well hydraulics. Group of wells. Pumping tests and their interpretation. Complex interpretation of groundwater data. Evaluation and interpretation of subsurface hydrodynamic data of extended regions. Hydraulics and hydrodynamics of petroleum entrapment and occurrences. Characterization of groundwater flow systems. P(z) profiles, fluid-potential maps, hydraulic cross-sections. Hydrogeothermal conditions. Over-pressured aquifers.UVZ methods. Entrapment potential.
Education method: Lectures with powerpoint slides, practises in the laboratory.
Competencies to evolve:

- Knowledge of exploration methods of oil and natural gas resources.
- Knowledge of exploitation methods of oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- David Daming, 2002: Introduction to Hydrogeology, McGraw-Hill Higher Education.
- Charles R. Fits, 2002: Groundwater Science. Academic Press, pp. 1-450.
- S. E. Ingebritsen, W. E. Sanford, 1998: Groundwater in Geologic Processes. CabridgeUniversity Press.
- Eric. C. Dahlberg, 1982: Applied Hydrodynamics in Petroleum Exploration, ISBN: 0-387-97880-1, Springer-Verlag.
- Willis D. Weight, 2004: Manual of Applied Field Hydrogeology, McGraw-Hill Professional Engineering.

Responsible Instructor(*name, position, scientific degree):*
Péter Szűcs Dr., professor, DSc

Course Title:Fluid mechanics and flow in porous media, transport modeling	**Credits: 3**

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

Type of Assessment (exam. / pr. mark. / other):**exam**
Two exercises and their reports have to be made during the semester, which are based on complex instrumental evaluation of rock samples as self-sufficient tasks. These exercises return the 40% of the grade at the end of the semester. The other 60% can be acquired at the written examination at the end of the semester.
Grading limits:
>80%: excellent,
70-80%: good,

60-70%: medium,
50-60%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:

Study goals: Indepth introduction to texture analysis of different rock types with special emphasis on reservoir properties of porous and fractured rocks, using different analytical techniques.The student will be familiar with the theoretical and practical relations of numerical calculation methods applied in modern hydrogeology. The students will get acquainted with a numerical calculation environment recognized also in the international practise. With this knowledge, they will be able to execute simple hydrodynamic and transport modeling tasks and will gain the fundamentals, whereby later they will be able to solve greater and more complex problems also on their own preparation.

Course content: High, medium and low enthalpy reservoirs. Fractured reservoirs (Liquid dominated reservoirs, Vapor dominated reservoirs). Artificial EGS reservoirs. Porous reservoirs. Low enthalpy porous systems. Medium and high enthalpy porous reservoirs. The necessity of well test information (reservoir fluid sampling, Modular Dynamic Testers, Pressure Transient Analysis). The course on groundwater modeling gives an overview on the possibilities of numerical simulation of groundwater in different reservoirs. This part of thee course is dominantly practice oriented that uses a freeware code called Processing MODFLOW to understand groundwater motion. The course starts with a short introduction to modeling principles and the theory of groundwater motion. After the short theoretical introduction simple examples the most important modeling techniques are presented to the students. During the rest of the semester a common work on computers is done to solve tasks of step-by-step increasing complexity.

Education method: Lectures with ppt presentation, laboratory exercises. The students must complete several stand-alone simulation tasks (homework) at home during the semester that makes a relevant part of the course grading.

Competencies to evolve:

- Knowledge of exploration methods of oil and natural gas resources.
- Knowledge of exploitation methods of oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to explore hydrocarbon-bearing geological structures in a workmanlike manner and to plan the exploitation process.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Bobok E.: Fluid Mechanics for Petroleum Engineers, Elsevier, Amsterdam, London, New York, Tokyo, 1993. ISBN:0-444-98668-5.
- L.P. Dake: Fundamentals of Reservoir Engineering (Developments in Petroleum Science) Elsevier, 2010, ISBN: 978-0-444-41830-2, ISSN: 0376-7361.
- Kresic (1997): Quantitative solutions in Hydrogeology and Groundwater Modeling, CRC Lewis Press.
- Chiang, W-Hs (2005): 3D-Groundwater Modeling with PMWIN: A Simulation System for Modeling Groundwater Flow and Transport Processes, Springer Verlag.

- Simcore Software (2012) Processing Modflow An Integrated Modeling Environment for the Simulation of Groundwater Flow, Transport and Reactive Processes, Users Guide.

Responsible Instructor(*name, position, scientific degree):*
Anikó Tóth Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):
Balázs Kovács Dr., associate professor, PhD
Elemér Bobok, professor, DSc

Course Title: Core analysis	**Credits: 3**

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

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

Written examination: recommended mark based on test paper, in case of disagreement oral examination.

Grading limits:
>89 %: excellent,
76-88 %: good,
63-75 %: medium,
50-62 %: satisfactory,
<50 %: unsatisfactory

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:Technical subject giving basis for specialization, which demonstrates the students the conventional (CCAL), and the so called special (SCAL) petrophysical measurements, measurement procedures and the documentation of measurement outcomes. Starting with the beginning of the process (the drifting of the core drilling), the student can get familiar with the different techniques of core drilling, treating/maintaining the core (preservation, discription, modelling), the core examining programme and through its documentation information deriving from cores.
Course content:Gaining the knowledge of core examining/measuring methods. Aim of coring. Coring technologies. Processing core. Non destructive processing (description, GR, Core Scanner, Computer Tomography). Grain size analysis (methodes: wet and dry etc). SEM and XRD@XRF etc. CCAL (plug): residual fluid saturation (Dean Stark), carbonate content, densities (bulk, grain, in conjuctions with porosity), porosity (Boyle's Law and restauration method), gas permeability (horizontal and vertical, Klinkenberg), liquid permeability (horizontal and vertical). SCAL (plug): porosity at overburden pressure (Boyle's Law method), gas permeability at net overburden pressure (pressure decay method), two phase relative permeability (steady, unsteady state methodes), capillary pressure tests, electrical resistivity measurements, acoustical velocity. Full Diameter Core Analysis (FDCA). Mechanical measurements (elastic – Young - modulus, Poisson, UCS etc).
Education method:Visiting core storing facilities.
Competencies to evolve:
- Experiencing complex engineering and economic processes by integrating the geological and geophysical exploration works and by joining with the quality management system.
- Knowledge of exploration methods of oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.

- Demand for continual renewal of technical skills.

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

Responsible Instructor(*name, position, scientific degree):*
Velledits Felicitász Dr., PhD, part-time associate professor

Course Title: Sedimentology of clastic reservoirs	**Credits: 3**

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

Type of Assessment (exam. / pr. mark. / other): **exam**
Signature's requirement: participation on lectures (zero unjustified absence) + at least one pass mark test paper. Written examination: recommended mark based on test paper, in case of disagreement oral examination.
Grading limits:
>89 %: excellent,
76-88 %: good,
63-75 %: medium,
50-62 %: satisfactory,
<50 %: unsatisfactory.

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

Pre-requisites *(if any)*:Applied petrology, Introduction to petrophysics.

Course Description:

Acquired store of learning:
Study goals:Sedimentology is concerned with the composition and genesis of sediments and sedimentary rocks. The subject gives tools and methods for the understanding and interpretation of sediments, their facies and spatial distribution. Facies models makes possible to predict distribution of facies of different origin thus helping exploration. The course gives also a comprehensive outline of the different methods of subsurface geology, which is of major importance in hydrocarbon exploration and water prospecting.
Course content:Sedimentology as an earth science: introduction and principles. Dimensions of geological knowledge. Harmonizing different scales (mega-, macro, and micro scales) of data. Subsurface geology: tools and available data. Seismic, well-logs, cores and others. Processes of deposition: weathering, transportation, sedimentation. Outline of sedimentary petrology: composition, texture and sedimentary structures. Factors controlling the nature and distribution of facies: sedimentary processes, supply, climate, tectonics and sea-level changes. Understanding of processes of deposition through sedimentary structures – characteristic of depositional processes. Applied geophysical methods: well (wireline) logs used for lithological and facies interpretation. Definition of facies, facies associations, and facies models. Definition of depositional environments. Relations between facies and depositional environments. Depositional systems: classification of depositional environments Detailed description of the individual clastic depositional environments (terrestric or continental environments, coastal and nearshore environments, marine environments). Understanding of depositional architecture in a mega (basin) and macro scale. Palaeogeographic reconstruction – how ancient environments can be reconstructed. Understanding of softwares helping the sedimentological interpretation in subsurface geology.
Education method:Presentations by projector. Basic practice in geologic well log interpretation.
Competencies to evolve:

- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.

- Demand for continual renewal of technical skills.

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

- Balogh Kálmán (szerk.): Szedimentológia. Akadémiai kiadó, Budapest, 1991.
- Bérczi István, Jámbor Áron (szerk.): Magyarország geológiai képződményeinek rétegtana. A MOL RT. és a MÁFI kiadványa, Budapest, 1988.
- S. Boggs: Principles of Sedimentology and Stratigraphy, Prentice Hall Publishing, 2011. ISBN-10: 0321643186 | ISBN-13: 978-0321643186.
- G. Nichols: Sedimentology and Stratigraphy. Wiley-Blackwell, 2009. ISBN: 978-1-4051-3592-4.
- G. P. Allen, A. Coadou, F. Mercier: Clastic Reservoir Sedimentology: A Practical Course on Log-based Sedimentological Analysis of Fluvial, Deltaic, and Coastal Clastic Reservoirs. (S.I.) Clastic sedimentology section, Total exploration laboratory, 1992.

Responsible Instructor(*name, position, scientific degree):*
Éva Hartai Dr., associate professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):
Györgyi Juhász Dr., PhD (MOL Group)

Course Title: Estimation of resources/reserves	**Credits: 2**

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

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

Graing limits:
>80%: excellent,
70-80%: good,
60-70%: medium,
50-60%: satisfactory,
<50%: unsatisfactory..

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:
Course content:Maturation classes of petroleum resources: prognostic, prospective, discovered (contingent), undeveloped and developed. The nature of uncertainties in resource estimations and the understanding of the associated geological risks. Parameters of volumetric calculations. The In-Place and the Recoverable (Technical) Resource volume categories. Summary of the probability theory: characteristics of probability variables, discrete and continuous variables, probability density and cumulative probability functions. Review of statistical methodologies: data categorizations, histograms, indices of averages and fluctuations. Introduction to the uncertainty-based pre- and post-discovery categorization of petroleum resources: probabilistic and deterministic approaches. Geostatistics based uncertainty evaluation of the volumetric calculation parameters (rock volumes, porosity, saturation, formation volume factors, recovery factor). The log-normal distribution of petroleum resources: characteristic values and the range of the uncertainty. Reserve estimations: definition of commerciality. Economic thresholds, marketability and legal criteria. Separation of reserves and contingent resources. Reserve reporting guidelines and reserve audits.
Education method:

Competencies to evolve:

- Knowledge of widely applicable problem solving techniques required for research or scientific work.
- Knowledge of global social and economic processes.
- The use of methods of computer planning and data analysis at user's level, the application of Geographical Information Systems.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to control the complex planning works of hydrocarbon exploration as well as conducting and participating in project management tasks.
- Ability to explore hydrocarbon-bearing geological structures in a workmanlike manner and to plan the exploitation process.
- Ability to enumerate the hydrocarbon resource qualitatively and quantitatively and make economic evaluation, to compile license materials, to review the related reports.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Miller, B.M., 1986: Resource Appraisal Methods: Choice and Outcome. In Rice ed.: Oil and Gas Assessment – Method and Applications. In AAPG Studies in Geology, No. 21.
- Quirk, D. G. Ruthrauff, R. G., 2008: Toward consistency in petroleum exploration: A systematic way of constraining uncertainty in prospect volumetrics. AAPG Bulletin, V. 92, No. 10.
- Rose, P.R., 2001: Risk Analyses and Management of Petroleum Exploration Ventures. In AAPG Methods in Exploration Series No. 12.
- SPE/AAPG/WPC/SPEE, 2007: Petroleum Resources Management System.
- Steiner, F., 1990: A geostatisztika alapjai. Tankönyvkiadó, Budapest.

Responsible Instructor(*name, position, scientific degree):*

István Bérczi Dr., professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Imre Szilágyi , assistant lecturer (Eötvös Loránd University)

Course Title: Petroleum economics	**Credits: 2**

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

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

The major examination will be a selection-test with closed book. It will cover all of the material in the course.

Grading limits:

90% or above 5, excellent
80% to 89% 4, good
70% to 79% 3, medium

60% to 69% 2, satisfactory
Below 60% 1, unsatisfactory

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals: are establishing interdisciplinary knowledge base for understanding and assessing business environment of E&P industry
Course content:Brief summary of some general economic issues in micro-economics.Basis of economic approach including cash flow modeling, time preference (concept of compound interest and present value). Forecast of key factors determining E&P business in the future. Methods determining key economic indicators. Features of appraisal an individual asset applying economic indicators and their constraints in risk-free case. Basic geological, technical and economical features of petroleum industry investment in case of exploration, field development, production and abandonment (risks, resources, reserves, venture capital). Summary of methods applied for estimation resources and reserves of E&P assets.Crude oil and natural gas price history and price forecasting models. Risks "measurements" and their impact on assets value (expected value concept, Monte Carlo simulation). Evaluation uncertainty and risk of various parameter estimates and their impact on (economic) indicators calculated. Non-quantifiable (risk) factors and their impact on asset evaluation.Evaluation of assets groups (portfolio assessment). The place and role of oil companies worldwide: typical contracts and tax systems in various countries ranked in terms of hydrocarbon availability, profitability and risk.
Education method: Presentation with slide show

Competencies to evolve:

- Knowledge of widely applicable problem solving techniques required for research or scientific work.
- Knowledge of global social and economic processes.
- The use of methods of computer planning and data analysis at user's level, the application of Geographical Information Systems.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to control the complex planning works of hydrocarbon exploration as well as conducting and participating in project management tasks.
- Ability to explore hydrocarbon-bearing geological structures in a workmanlike manner and to plan the exploitation process.
- Ability to enumerate the hydrocarbon resource qualitatively and quantitatively and make economic evaluation, to compile license materials, to review the related reports.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Seba, R.D. (1998): Economics of Worldwide Petroleum Production. OGCI Publications Tulsa, p.582.
- Megill, R.E. (1984): An Introduction to Risk Analysis. PennWell Books Tulsa, p.274, ISBN 0878142576.

- Daniel Johnston (1992): Oil Company Financial Analysis in Nontechnical Language (Pennwell Nontechnical Series).
- SPE (2007): Petroleum Resources Management System http://www.spe.org/industry/reserves/docs/Petroleum_Resources_Management_System_2007.pdf
- SPE (2011): Guidelines for Application of the Petroleum Resources Management System http://www.spe.org/industry/docs/PRMS_Guidelines_Nov2011.pdf

Responsible Instructor(*name, position, scientific degree):*
Zsolt Komlósi Dr., honored associate professor

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):
Imre Szilágyi , assistant lecturer (Eötvös Loránd University)

Course Title: Analysis of petroleum systems, prospect evaluation	**Credits: 3**

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

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

Grading limits:
>80%: excellent,
70-80%: good,
60-70%: medium,
50-60%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:
Course content:This topic presents a modern approach to the analysis of sedimentary basins, emphasizing the fundamental controls on basin development. The mechanisms controlling large-scale basin evolution are integrated with structural evolution and sedimentary processes. Analysis techniques include quantitative geophysical modelling, seismic interpretation and detailed sedimentary and stratigraphic analysis of basin infill. Fundamentals of play-based exploration aimed at demonstrating the integration of all aspects of petroleum exploration and petroleum systems analysis. The course includes seismic interpretation, well correlation and common risk segment mapping and the integration of reservoir, source, seal and trap analysis. Prospect and play risk analysis is also outlined as a basis for generating a consistent approach to estimating risked volumetric estimations. This course is deliberately practical and is used as a precursor to the annual European Heath of the Imperial Barrel Award competition (AAPG).
Education method:
Competencies to evolve:

- Experiencing complex engineering and economic processes by integrating the geological and geophysical exploration works and by joining with the quality management system.
- The use of methods of computer planning and data analysis at user's level, the application of Geographical Information Systems.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to control the complex planning works of hydrocarbon exploration as well as conducting and participating in project management tasks.

- Ability to explore hydrocarbon-bearing geological structures in a workmanlike manner and to plan the exploitation process.
- Ability to enumerate the hydrocarbon resource qualitatively and quantitatively and make economic evaluation, to compile license materials, to review the related reports.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

Responsible Instructor(*name, position, scientific degree):*
Ferenc Mádai Dr., associate professor, Phd

Other Faculty Member(s) Involved in Teaching, if any (*name*, *position*, *scientific degree*):
Ahmed Amran Dr., PhD (MOL Group)

Course Title: Reservoir geology and modeling	**Credits: 3**

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

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

Grading limits:
>80%: excellent,
70-80%: good,
60-70%: medium,
50-60%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:Reservoir geology is a fundamental skill to integrate data from various disciplines at different scales from the exploration to the production of oil and gas. Through 3D modelling and visualisation packages high-resolution models but require well trained professionals with good command on the basics and on manual skills of core-, log-, test evaluation and mapping procedures to properly select input and to understand and validate output data (QC).
Course content:Introduction – aims and role of integrated reservoir management in the upstream value chain.Reservoir Geology – why is it a fundamental component in reservoir management?Phases in Reservoir Geology: from operative plans to strategic vision.Consistency and coherency: key elements of understanding our reservoirs properly. Duties of geoscientists and engineers. Analysis of Reservoir Rocks – the only source of direct measurements and observations. Cores and core description. Lithology, facies and facies groups, lithostratigraphy. Depositional and diagenetic history: main factors controlling reservoir heterogeneity. Conventional (CCAL) and special core analysis (SCAL): elements connecting static and dynamic models. Determination of reservoir geometry – steps to determine reservoir bulk rock

volume (BRV). Stratigraphic correlation panels: zonation of stratigraphic sequences. Tectono-stratigraphic charts: summarising stratigraphic units and hiatus. Structural cross sections: determination and visualisation of structural elements. Reservoir zonation: determining and visualising reservoir complexity as the main element controlling subsurface fluid flow. Determination of Pay Rock Volume (PRV). Tectonic/structural implications controlling the spatial extension of reservoir rock(s). Lithological and petrophysical implications controlling reservoir rock heterogeneity andsubsurface flow. Definition of fluid contact types. Vertical delineation of PRV: practical determination of oil/water and gas/oil contacts. Visualisation of hydrocarbon saturation distribution: contact charts and saturation profiles. Reservoir geological (static) model and volumetric determination of Petroleum Initially - in – Place (PIIP). Selection, acquisition, integrated validation and management of subsurface data for calculating PIIP. Assessment of uncertainties in delineation of pay rock volume. Mapping reservoir structure, gross and net thickness, and reservoir properties. Rules of determining and mapping reservoir thickness values. Principles of mapping reservoir parameters. Steps of building a high resolution 3-D model. Feedback from dynamic model and field performance data to upgrade the static model. Resource – reserves categorization (terms and definitions;classification/categorization systems,SEC and SPE-PRMS, UNFC as most frequently used systems; challenges and responses).

Education method:

Competencies to evolve:

- Experiencing complex engineering and economic processes by integrating the geological and geophysical exploration works and by joining with the quality management system.
- Knowledge of geological and geophysical surveying methods suitable to find oil and natural gas resources.
- Knowledge of exploration methods of oil and natural gas resources.
- The use of methods of computer planning and data analysis at user's level, the application of Geographical Information Systems.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to explore hydrocarbon-bearing geological structures in a workmanlike manner and to plan the exploitation process.
- Ability to enumerate the hydrocarbon resource qualitatively and quantitatively and make economic evaluation, to compile license materials, to review the related reports.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- István BÉRCZI: Development Geology, HOT Engineering, 2009. 480p.
- CATAPANG, Timothy John: Basic Petroleum Geology.
- SELLEY, R. C.: Elements of Petroleum Geology.
- University of Texas: Petroleum Geology & Reservoirs, www.utexas.edu.
- Ashton, Michael: Advances in reservoir geology. The Geological Society, 1992 - 240 p.
- Hocott, C. R.: Basic reservoir engineering for geologists., The Geological Society, 1978 - 42 p.

Responsible Instructor(*name, position, scientific degree):*

István Bérczi Dr., professor, PhD

Course Title: In-field seismic techniques and interpretation	**Credits: 4**

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week: **lec. 1, sem. 3**

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

Solving practical problems. Evaluation of the self-sufficient task, and/or oral exam (under the system in ECTS).

Grading limits:
>86%: excellent,
71-85%: good,
61-70%: medium,
46-60%: satisfactory,
<45%: unsatisfactory.

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

Pre-requisites *(if any)*:Exploration Seismic Techniques and Interpretation

Course Description:

Acquired store of learning:
Study goals:Based on the lectures delivered in the course titled "Exploration Seismic Techniques and Interpretation" advanced geophysical methods are also illustrated in relation to the application of reservoir geophysics to field development and reservoir management: 3-D/4-D seismic, share waves and 3 component (3-C) data recording and data processing, 3-D visualisation, amplitude studies, AVO, and elastic inversion. The petroleum production significance associated with each seismic data set evaluated is emphasized.
Course content:Introduction to reservoir geophysics. Practical role of surface geophysical methods in oil and gas reservoirs exploration, development and production. The life cycle of the reservoir in O&G industry, the main aspects of economic decision-making, the role of geotechnical information in decision-making. Geophysical information to the field development plan, the static reservoir models. Structural uncertainty, velocity modeling, depth conversion. DHI analysis. Mapping of facies and characteristics, seismic inversion. Pressure and saturation monitoring, 4-D seismic method.
Education method: Electronic presentationsby PC and projector. Software: OpendTect system installed on workstation.

Competencies to evolve:

- Knowledge of exploration methods of oil and natural gas resources.
- Knowledge of exploitation methods of oil and natural gas resources.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- William L. Abriel, 2008: Reservoir Geophysics: Applications, SEG Books.
- W. Ashcroft, 2011: A Petroleum Geologist's Guide to Seismic Reflection.
- M. Bacon, R. Simm, T. Redshaw, 2003: 3-D Seismic Interpretation.

- Per Avseth, Tapan Mukerji, Gary Mavko, 2005: Quantitative Seismic Interpretation: Applying Rock Physics Tools to Reduce Interpretation Risk.
- Handouts delivered by the Hungarian Oil and Gas Company.

Responsible Instructor(*name, position, scientific degree):*
Tamás Ormos Dr., professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):
Endre Turai Dr., associate professor, CSc/PhD
László Gombár Dr. (Geoseis Consulting)
Péter Zahuczki (MOL Group)

Course Title: Reservoir engineering	**Credits: 4**

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week:**lec. 3, sem. 1**

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

Grade is offered based on final written exam. Without agreement oral examination.

Grading limits:
90 >%: excellent,
81-90 %: good,
71-80 %: satisfactory,
60-70%: pass,
60<%: unsatisfactory.

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

Pre-requisites *(if any)*: Core analysis.

Course Description:

Acquired store of learning:
Study goals:To give a sort overview basic definition, tools, evaluation and calculation methods that widely use in reservoir engineering practice. Preparing the reservoir geologist to work in a team with the reservoir engineers, during the characterization of hydrocarbon resources. Give a general overview how to design, forecast, and operate the production of hydrocarbon fields in reservoir engineering point of view.
Course content:Properties of hydrocarbon bearing lazer. Capillary pressure and relative permeabilities, and their measurement. Phase behavior of reservoir fluids. Single and multi component systems. Vapor-fluid equilibrium. Classification of hydrocarbon reservoir based on phase diagram. Practical application of correlation methods which are able to calculate fluid phase behavior and pressure and temperature dependent properties like formation volume factor, density, viscosity, solution gas etc. Determination of initial hydrocarbons in place via volumetric and statistical methods. Immiscible, two phase flow, frontal oil displacement. Material balance equation of oil reservoirs. Average pressure. Drive mechanics, drive indices. Material balance equation of a gas reservoir. Water influx. Volumetric and open reservoirs. Hydrocarbon in place estimation with material balance. Havlena-Odeh, Tehrani methods. Prediction with material balance. Basic hydrodynamical measurements (capacity and pressure drowdown and buildup) done in oil, gas and water producing wells. Usining vertical, vertical-fractured, and horizontal wells in reservoir enginering practices.
Education method:Lecture: Power point presentations, animations, handouts. Lab exercises: demonstration measurements, discussions; hands-on calculation exercises, computer modeling (group assignments)
Competencies to evolve:
- Knowledge of exploitation methods of oil and natural gas resources.

- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- J. Pápay: Development of Petroleum Reservoirs, Akadémiai K., Budapest 2003.
- János Török, Lipót Fürcht, Tibor Bódi: PVT Properties of Reservoir Fluids. (Könyv). University of Miskolc Miskolc, Hungary 2012. ISBN 978-963-661-988-5 p. 1-192.
- Towler: Fundamental Principles of Reservoir Engineering, SPE Textbook Series, Vol. 8., 2002, ISBN 1-55563-092-8.
- C. H Whitson, M. R. Brule: Phase Behavior. SPE Monograph Volume 20. Richardon, Texas, 2000. ISBN: 978-1-55563-087-4.
- Roland N. Horne: Modern Well Test Analysis a Computer-Aided Approach. Petroway, Inc. California, USA 1995. ISBN 0-9626992-1-7.

Responsible Instructor(*name, position, scientific degree):*

Zoltán Turzó Dr., associate professor, PhD

Course Title: Planning, implementing and managing E&P projects	**Credits: 2**

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

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

Grading limits:
>80%: excellent,
70-80%: good,
60-70%: medium,
50-60%: satisfactory,
<50%: unsatisfactory..

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

Pre-requisites *(if any)*: Core analysis.

Course Description:

Acquired store of learning:
Study goals:During the semester students get global overview about value creation for the stakeholders and its processes of the hydrocarbon exploration and production activity. Students to learn the best practices and standards of the exploration and production projects planning, execution and monitoring. Get students practice the basis of the modern project management.
Course content:The players of the global oil and gas industry. The hydrocarbon exploration and production value chain. Strategy, developing oil and gas projects. Acces and lease exploration and production rights. Planning and controlling upstream projects. Legal framework, PSA, JOA, JV. Fiscal regimes, oil and gas projects economics. Risk management, managing technical, political and partner risks. Product management, sales contracts. Resources and reserves disclosure and reporting.

Education method:Lectures, powerpoint projected slides. Miscrosoft Offic programs are used during the practice.

Competencies to evolve:

- Knowledge of widely applicable problem solving techniques required for research or scientific work.
- Knowledge of global social and economic processes.
- The use of methods of computer planning and data analysis at user's level, the application of Geographical Information Systems.
- Ability to understand the laws and connections and to apply the acquired knowledge.
- Ability to control the complex planning works of hydrocarbon exploration as well as conducting and participating in project management tasks.
- Ability to enumerate the hydrocarbon resource qualitatively and quantitatively and make economic evaluation, to compile license materials, to review the related reports.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- The Global Oil & Gas Industry; Management, Strategy and Finance Andrew Inkpen / Michael H. Moffett.

Responsible Instructor(*name, position, scientific degree):*
István Bérczi Dr., professor, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):
András Király (MOL Group)
Imre Szilágyi, assistant lecturer (Eötvös Loránd University)

Course Title: Project work	**Credits: 8**

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week:**sem. 8**

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

Grading limits:
>80%: excellent,
70-80%: good,
60-70%: medium,
50-60%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*: Core analysis.

Course Description:

Acquired store of learning:
Education method:Imperial Barrel Award type project development (8 ECTS) teamwork.

Competencies to evolve:

- Knowledge of widely applicable problem solving techniques required for research or scientific work.
- Knowledge of global social and economic processes.
- Experiencing complex engineering and economic processes by integrating the geological and geophysical exploration works and by joining with the quality management system.
- The use of methods of computer planning and data analysis at user's level, the application of Geographical Information Systems.
- Knowledge to be able to participate in the scientific research work, including the PhD program.
- Ability to control the complex planning works of hydrocarbon exploration as well as conducting and participating in project management tasks.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to plan the surface and well-logging geophysical investigations, to make and control measurements, to process and evaluate the measurement data, to make geological and geophysical interpretation, to review these operations.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.
- Creativity, skill to recognize and solve problems, ambitious work.
- Intuition, systematism, learning skill.
- Proper motivation for operating under often-changing work and geographical conditions.
- Communication skills.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Demand for continual renewal of technical skills.
- Initiative and decision-making capabilities, assuming and practising personal responsibility.
- Suitability for co-operation, for participating in team work, and for pursuing managerial tasks after sufficient practice.

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

Responsible Instructor(*name, position, scientific degree):*
János Földessy Dr., professor, CSc

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):
Endre Turai Dr., associate professor, CSc, PhD
Felicitász Velledits Dr., PhD, part-time associate professor
Norbert Németh Dr., assistant professor, PhD
Tibor Bódi Dr., associate professor, PhD
András Király (MOL Group)
Viktor Lemberkovics (MOL Group)

Course Title: Research- or exploration-based thesis work	**Credits:30**

Type (lec. / sem. / lab. / consult.) and Number of Contact Hours per Week:**consult. 4**

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

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:Students have to carry out a final thesis at the end of their course of study, under the guidance of a thesis supervisor(s). The thesis is a permanent part of the curricular structure with its own credit weighting. The purpose of writing the Master's thesis is for the students to identify and clarify a problem or an issue by applying the theories and methods acquired through their undergraduate and graduate studies. The aim of the final thesis is for students to show that they can apply knowledge, theories and methods gained during the degree programme. Students should be able to design and carry out their own research agenda by carefully choosing their methodology and critically drawing on the existing literature to analyse and draw conclusions from their own empirical data.
Course content:Assigned topic.
Education method:Appropriate technical background will provide for every student. Literature will be suggested. Permanent consultancy will provided.

Competencies to evolve:

- Knowledge of widely applicable problem solving techniques required for research or scientific work.
- Experiencing complex engineering and economic processes by integrating the geological and geophysical exploration works and by joining with the quality management system.
- The use of methods of computer planning and data analysis at user's level, the application of Geographical Information Systems.
- Knowledge to be able to participate in the scientific research work, including the PhD program.
- Knowledge to be able to participate in the scientific research work, including the PhD program.
- Ability to plan the surface and well-logging geophysical investigations, to make and control measurements, to process and evaluate the measurement data, to make geological and geophysical interpretation, to review these operations.
- Ability to participate in solving geological and geophysical problems arising in hydrocarbon mining (planning, investment, maintenance, abandonment), and to analyze the possible solutions for the above purposes.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Creativity, skill to recognize and solve problems, ambitious work.
- Intuition, systematism, learning skill.
- Communication skills.
- Demand for continual renewal of technical skills.
- Initiative and decision-making capabilities, assuming and practising personal responsibility.

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

Depending on the topic of the thesis, literature is recommended by the responsible instructor of the thesiswork.

Responsible Instructor(*name, position, scientific degree):*

Endre Turai Dr., associate professor, CSc/PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

István Bérczi Dr., professor, PhD

FelicitászVelledits Dr., PhD, part-time associate professor

Norbert Péter Szabó, associate professor, PhD

Course Title: Introduction to geophysical literature (Optional courses I.)	**Credits: 2**

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

Type of Assessment (exam. / pr. mark. / other):**pr. mark**
Attendence at lectures is regulated by the university code of education and examination. Writing one test at the end of the term. Making one powerpoint presentation on an assigned topic.
Grading limits:
>86%: excellent,
71-85%: good,
61-70%: medium,
51-60%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:The course provides as a guide to orientate in geophysical literature and make acquaintance with geophysical terminology.
Course content: Applied geophysical exploration and data processing methods are studied and analyzed by technical encyclopedias, book chapters, articles of scientific (impact factor) journals and conference proceedings. Learning the rules of scientific paper writing, preparing conference speeches and presentation materials. Practising the communication withEnglish-speaking professionals.
Education method:Continuous dialogue between the instructor and students. Translation exercises, reading, delivering presentation in a simulated conference, contributions. Meeting with English-speakinglecturers and professionals staying at the university.
Competencies to evolve:

- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Knowledge to be able to participate in the scientific research work, including the PhD program.
- Intuition, systematism, learning skill.
- Communication skills.
- Demand for continual renewal of technical skills.
- Active professional English language skills.

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

- Ellis D. V., Singer J. M., 2007: Well logging for earth scientists. 2nd edition. Springer.
- Kearey P., Brooks M., Hill I., 2002: An Introduction to Geophysical Exploration. Third edition. Blackwell Science Ltd.
- Lowrie W., 2007: Fundamentals of Geophysics. Second Edition. Cambridge University Press.
- Sheriff R. E., 2002: Encyclopedic Dictionary of Applied Geophysics. Fourth edition. Society of Exploration Geophysicists.
- Selected papers from scientific journals: Geophysics, Petrophysics, Journal of Applied Geophysics, Mathematical Geosciences, Hydrogeology Journal etc.

Responsible Instructor(*name, position, scientific degree):*
Norbert Péter Szabó Dr., associate professor, PhD

Course Title: Graduate research seminar (Optional courses I.)	**Credits: 2**

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

Type of Assessment(exam. / pr. mark. / other):**pr. mark**
During the semester the following tasks should be completed: short presentation of the selected topic, outline and references (20%), elaboration of the concept map of the article (20%), submission of first draft (15%), submission of the final text (20%), ppt presentation of the topicin 10 minutes (25%).
Grading limits:
>80%: excellent,
70-79%: good,
60-69%: medium,
50-59%: satisfactory,
<50%: unsatisfactory.

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

Pre-requisites *(if any)*:

Course Description:

Acquired store of learning:
Study goals:To introduce the methods of information gathering and evaluation, formal and ethic requirements of scientific communication, rules for preparation of oral and poster presentations. During the course these general requirements are actualized to the field of earth science and engineering. Examples and excercises will use English publications and text materials.
Course content:Editorial and formal requirements of scientific publications. Planning of the concept and structure of a scientific publication, making an outline, development of a concept map. Usage of references, reference styles. Etics of scientific writing: how to avoid plagiarism, usage of citations. Information sources provided by the Central Library: hard copy, catalogue search, electronic resources. Usage of electronic information resources: search options, simple and combined search, electronic libraries. Data visualization: graphs, figures, tables. The art of presentation: preparation for an oral contribution. The art of presentation: preparation of a poster. "As I do it", recommendations from leading professors of the faculty on the above topics.
Education method:Completion of a 3-4 pages paper on a specified topic from petroleum geoscience. It should be a literature summary with at least one table and one figure. The paper should fulfil all formal requirements of a scientific paper. Completion of a 5-minutes presentation on the above mentioned specified topic. It should be presented for the class audience.
Competencies to evolve:

- Knowledge to be able to participate in the scientific research work, including the PhD program.
- Ability to analyze the geological and geophysical conditions of hydrocarbon reservoirs, to prepare exploration and technical operation plans, to perform the exploration work technically and to control that, to prepare and review (final) reports.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Communication skills.
- Demand for continual renewal of technical skills.
- Active professional English language skills.

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

- L. C. Perelman, J. Paradis, and E. Barrett: The Mayfield Handbook of Technical and Scientific Writing (McGraw-Hill, 2001).
- G. J. Alred, C. T. Brusaw, and W. E. Oliu: Handbook of Technical Writing, (St. Martin's, New York, 2003).
- Hagan P; Mort P: Report writing guideline for mining entógineers. Mining Education Australia, 2014.
- Chun-houh Chen, Wolfgang Härdle, Antony Unwin (eds.) Handbook of Data Visualization (Springer, 2008).

Responsible Instructor(*name, position, scientific degree):*
Ferenc Mádai Dr., associate professor, PhD

Course Title: X-ray diffracion applications for petroleum geology (Optional courses II.)	**Credits: 2**

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

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

Test with 100 multiple-choice questions.
Grading limits:
>90%: excellent,
76-90%: good,
60-76%: medium,
50-60%: satisfactory,
<50%: unsatisfactory.

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

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

Course Description:

Acquired store of learning:
Study goals:This course will give the basic knowledge of XRD techniques used in petroleum geology research to support the planning and interpretations of petrology and petrography results. Meet and learn all the areas of X-ray diffraction which are routinely used and necessary in good quality petroleum geology research. The areas from sampling and specimen preparation to data evaluation and interpretation will be covered.
Course content: 1. Introduction to X-ray diffraction: crystallography review, X-rays and diffraction techniques, powder diffraction 2. Sample and specimen preparation for good diffraction practice, systematic aberrations, errors in obtained data, standards and calibration 3. Relations of crystal structures and XRD results, structure refinement 4. Interpretation of obtained data, mineral identification, proper use of databases, reference materials, integration of mineralogy knowledge into X-ray data evaluation 5. Quantitative evaluation, methods and practices, possibilities and limitations, software solutions 6. Mineral identification and quantification with solid solution species, use of mixtures from reference materials 7. Clay minerals, crystallography and mineralogy, properties, importance in petroleum geology, their investigation by XRD 8. Preparation of clay mineral samples and specimens, limitations, diagnostic chemical treatments 9. Diagnostic clay mineral investigation, detailed identification, data interpretation and integration into XRD mineralogy 10. Quantitative techniques for clay mixtures 11. Other analytical methods for XRD data validation, integration of chemical and petrology results 12. Preparing and selecting essential data for petrology report, documentation solutions 13. Testing the ability to apply XRD knowledge in petrology research planning.
Education method:Lectures with .ppt presentation, laboratory exercises for sample and specimen preparation, data evaluation, interpretation of results, methods for data validation and documentation.
Competencies to evolve:

- The use of methods of computer planning and data analysis at user's level, the application of Geographical Information Systems.
- Ability to enumerate the hydrocarbon resource qualitatively and quantitatively and make economic evaluation, to compile license materials, to review the related reports.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Bish D.L. & Post J.E. (eds.) (1981) Modern Powder Diffraction./Reviews in Mineralogy, **20**/. Mineralogical Society of America, Washington, D.C.
- Woolfson, M.M. (1997) An Introduction to X-ray Crystallography. 2nd ed. Cambridge University Press, Cambridge.
- Pecharsky, V.K. & Zavalij, P.Y. (2003) Fundamentals of Powder Diffraction and Structural Characterization of Materials. Kluwer, Dordrecht.
- Jenkins, R. & Snyder, R. (eds.) (2002) Introduction to X-ray Powder Diffractometry. Wiley, New York.
- Cullity, B.D. (1956) Elements of X-ray Diffraction. Addison-Wesley, Reading, Massachusetts.
- Guinier, A. (1952) X-ray Crystallographic Technology. Hilger and Watts, London.
- Dinnebier, R.E. & Billinge, S.J.L. (eds.) (2008) Powder Diffraction: Theory and Practice. Royal Society of Chemistry, Cambridge.
- Klug H. P. & Alexander L. E. (1974) X-Ray Diffraction Procedures: For Polycrystalline and Amorphous Materials. John Wiley & Sons, Inc., New York.

Responsible Instructor(*name, position, scientific degree):*

Ferenc Kristály Dr., research engineer, PhD

Course Title: Basic data processing methods for oilfield geophysics and petrophysics (Optional courses II.)	**Credits: 2**

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

Type of Assessment (exam. / pr. mark. / other):**pr. mark**
Attendence at lectures is regulated by the university code of education and examination. Writing two tests and making two software tasks during the semester.
Grading limits:
>86%: excellent,
71-85%: good,
56-70%: medium,
41-55%: satisfactory,
<40%: unsatisfactory.

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

Pre-requisites *(if any)*: -

Course Description:

Acquired store of learning:
Study goals:The course gives mathematical fundamentals ofdata processing methods and its usage in fields of oilfield geophysics and petrophysics.
Course content:Basis of information theory. Signal theory. Basis of the inverse data- and information processing. Modelling, type of the model. Theoretical and measuring characteristics. Error parameters in data domain and in the model space. Main part of the local and global inverse methods. Spectral transformation (Fourier-transform, Discrete Fourier Transform, Fast Fourier Transform, Z-transform). Convolution, discrete convolution, Correlation functions, discrete correlation functions. Deterministic and Stochastic filtering, Image processing filtering.
Education method:Practices usingsoftwares and ppt presentation to know processing methods.
Competencies to evolve:
- The use of methods of computer planning and data analysis at user's level, the application of Geographical Information Systems.
- Ability to process the exploration and production data, and to organize the data to Geographical Information Systems data bases.

- Ability to plan the surface and well-logging geophysical investigations, to make and control measurements, to process and evaluate the measurement data, to make geological and geophysical interpretation, to review these operations.
- Ability to participate in PhD programs in case of fulfillment of law or regulations determined by the institution.
- Intuition, systematism, learning skill.
- Demand for continual renewal of technical skills.

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

- Meskó A, 1984: Digital filtering. Academic Press Inc, Budapest.
- Menke, W, 1984: Geophysical Data Analysis: Discrete Inverse Theory. Academic Press Inc.
- Candy, J V, 1986: Signal Processing, McGraw-Hill Book Co.
- Bath, M, 1974: Spectral Analysis in Geophysics, Elsevier Scientific Publishing Co.
- Bracewell, R N, 1978: The Fourier Transform and its Applications, McGraw-Hill Book Co.

Course Managed by (*name, position, scientific degree):*

Endre Turai Dr., associate professor, CSc, PhD

Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Mihály Dobróka Dr., professor, DSc

Norber Péter Szabó Dr., associate professor, PhD

Géza Wittmann Dr. (MOL Group)