Syllabuses

MS in Petroleum Engineering

Subject	Code
Numerical Methods and Optimization	GEMAK712MA
Applied Geology	MFFTT710003
Computer Applications I.	MFKOT710019
Applied Geophysics	MFFGT710005
Oilfield Chemistry	MFKOT720011
Geothermal Energy	MFKGT740011
Petroleum Economics	MFKOT720012
HSE in Petroleum Engineering	MFKOT71011
Compulsory Electives 1. Gas procecessing	MFKOT77003
Comp.Electives 2. Hydrogeology	MFKHT730017
Comp. Electives 2. Geothermal well drilling	MFKOT730025
Free Electives Process sim. u. ASPEN HYSY	MFKOT710021
Computer Applications II.	MFKOT720021
Graduate Research Seminar	MFFAT720007
Drilling Engineering I.	MFKOT720022
Well Control Lab	MFKOT730014
Production Engineering Fundamentals	MFKOT720025
Artificial Lifting I.	MFKOT720017
Reservoir Engineering Fundamentals	MFKOT720024
Fluid Mechanics	MFKGT710005
Drilling Engineering II.	MFKOT730033
Artificial Lifting II.	MFKOT730031
Flow in Porous Media	MFKOT730035
Material Balance	MFKOT730026
Transport of Hydrocarbons	MFKOT730036
Well Completion Design	MFKOT720014
NODAL analysis applications	MFKOT730016
Reservoir Management, Simulation Lab	MFKOT730015
EOR Methods	MFKOT740013

Miskolc, 2019. február 01.

Dr. Turzó Zoltán
szakfelelős

Miskolci Egyetem Műszaki Földtudományi Kar Kőolaj- és Földgáz Intézet

Course Title: Numerical Methods and Optimization **Instructor:** Dr. Józsefné MÉSZÁROS retired associate professors	**Code:** GEMAK712MA **Responsible department/institute: GEMAN** **Course Element: Compulsory**
Position in curriculum (which semester): 1(4)[1]	**Pre-requisites (if any): -**
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** practical mark
Credits: 2	**Course:** full time

Course Description:

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

1. Extrema of functions.
2. Unconstrained and constrained optimization.
3. Convex optimization.
4. Minimization of functions with one variable (golden section, parabola method).
5. Minimization of multivariable functions (Nelder-Mead, Newton, modified Newton, quasi-Newton, minimization with line search).
6. Methods of penalty functions.
7. Multiaided and multicriteria decision problems (Pareto efficient solutions).
8. Linear programming.
9. About Soft Computing (SC) methods: fuzzy systems
10. About Soft Computing (SC) methods: genetic algorithms
11. About Soft Computing (SC) methods: neural network
12. Numerical solutions of ordinary differential equations and system of equations: Runge-Kutta,
13. Numerical solutions of ordinary differential equations and system of equations: predictor-corrector
14. Numerical solutions of ordinary differential equations and system of equations: finite differences.

Competencies to evolve:
Knowledge: T11
Ability: K4, K5, K6, K7, K8, K9, K10, K11;
Attitude:
Autonomy and responsibility: F1, F3, F4, F5

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	15 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Égertné, M. É., Kálovics, F., Mészáros, G.: Numerical Analysis I.-II. (Lecture notes), Miskolci Egyetemi Kiadó (1992), 1-175.
- R. Fletcher: Practical Methods of Optimization, John Wiley &Sons, 2000.

[1] First number: in case of fall term start, (number in bracket): in case of spring term start.

- P. E. Gill, W. Murray, M. H. Wright: Practical Optimization, Academic Press, 1981.
- J. Nocedal, S. J. Wright: Numerical Optimization, Springer, 2000.
- *Galántai Aurél-Jeney András*: Numerikus Módszerek; Miskolci Egyetemi Kiadó, 1997.
- *Galántai Aurél*: Optimalizálási módszerek; Miskolci Egyetemi Kiadó, 2004.

Course Title: Applied Geology **Instructor:** Felicitász VELLEDITS associate professor	**Code:** MFFTT710003 **Responsible department/institute: MFFTT** **Course Element: Compulsory**
Position in curriculum (which semester): 1(4)	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination/ practical mark / other):** examination
Credits: 3	**Course:** full time

Study goals:

To acquaint students with geological and geophysical knowledge that is essential for hydrocarbon exploration. To familiarize the sedimentary rocks, which can serve as source rocks, reservoir rocks or seals. The show the relationship between hydrocarbon generation, migration and trapping. To highlight the close connection between sedimentation and reservoir productivity.

Course Description:

01 Relationship of petroleum geology to science
02 Sedimentary basins and petroleum systems
03 Plate tectonic and reservoirs
04 Rock types, Sedimentary rocks
05 Stratigraphy
06 Petroleum system, The nature and formation of hydrocarbon
07 Migration, Source rocks
08 Reservoir Seal
09 Traps
10 Fluvial deposits and reservoirs
11 Aeolian sediments and reservoirs
12 Carbonate reservoir, Differences between carbonate and siliciclastic reservoirs
13. Unconventional hydrocarbons 1: Shale gas, Oil shale
14. Unconventional hydrocarbons 2: Oil sand, Gas hydrates, Coalbed methane

Competencies to evolve:
Knowledge: T2, T3, T6, T7, T8, T11
Ability: K4, K5, K6, K7, K8, K9, K10, K11
Attitude:
Autonomy and responsibility: F1, F2, F4, F6, F7

Assessment and grading:

Two written exam: Midterm exam, and Final exam. In both exam must be reached 59%.

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Stoneley, R.: Introduction to Petroleum Exploration for Non-geologists. Oxford University Press, 1995, ISBN 0 19 854856 7
- Landes, K. K.: Petroleum Geology. John Wiley & Sons, 1959
- Pápay, J.: Development of Petroleum Reservoirs. Akadémiai Kiadó, 2003, ISBN 963 05 7927 8
- Selley, R., Sonnenberg, S.: Elements of Petroleum Geology 3rd edition, Elsevier, 2014., Hardcover ISBN: 9780123860316
- Bjorlykke, K.: Sedimentology and Petroleum Geology, Springer Verlag, 1989., ISBN: 978-3540176916

Course Title: Computer Applications I. **Instructor:** Dr. Zoltán TURZÓ, associate professor	**Code:** MFKOT710019 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 2 (1)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 0+3	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 3	**Course:** full time

Course Description:

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

Competencies to evolve:
Knowledge: T8, T11
Ability: K4, K5, K6, K7, K8, K11
Attitude:
Autonomy and responsibility:

Assessment and grading:
Students will be assessed with using the following elements.

Attendance:	5 %
Homework	20 %
Midterm exam	30 %
Final exam	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

1. User manual of Microsoft Word.
2. User manual of Microsoft Excel.
3. User manual of AutoCad.
4. Mansfield R.: Mastering VBA for Microsoft Office 2016 3rd Edition, Sybex
5. Wverka P.: Office 2016 All-In-One For Dummies 1st Edition, John Wiley & Sons

Inc., New Jersey, 2016.

Course Title: Applied Geophysics **Instructor:** Dr. Gábor PETHŐ, private professor Dr. Péter Vass associate professor	**Code:** MFFGT710005 **Responsible department/institute: MFGFT** **Course Element: Compulsory**
Position in curriculum (which semester): 1(2)	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination/ practical mark / other):** examination
Credits: 3	**Course:** full time

Study goals: to have knowledge in applied geophysics and well logging used in HC exploration in the level of discussion with geophysicists and log analysts.

Course Description:

1. The most important geophysical parameters used in HC exploration.
2. Geophysical exploration (magnetic, gravity, electromagnetic, radiometry, geothermal) methods, their resolutions and their role in HC exploration.
3. Seismic reflection method, corrections made on seismic data to gain seismic section in depth. VSP.
4. Geophysical methods detecting HC in direct way (bright spot, AVO analysis).
5. Time-lapse (including 4D) geophysical measurements.
6. Physical bases and instrumentation of bore-hole geophysical measurements.
7. The main features of wire line logging.
8. The main features of logging while drilling and production well logging.
9. The determination of porosity, permeability, water and HC saturation.
10. Log indicators of over pressured zones.
11. Technical measurements and their applications.
12. Information gained by logging in cased holes.
13. Detecting well problems.
14. Application of logging in injection, production and monitoring wells.
15. Geophysical case histories including exploration and production.Competencies to evolve:

Knowledge: T1, T2, T3, T6, T7, T8, T11
Ability: K1, K6, K7, K8, K11
Attitude:
Autonomy and responsibility: F1, F2, F4, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Homework	5 %
Midterm exam	40 %
Final exam	50 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Telford W. M., Geldart L. P., Sheriff R. E.: Applied Geophysics. 2nd Edition. Cambridge University Press, 1990.
- Sheriff R.E., Geldart L.P. : Exploration Seismology 2nd Edition, Cambridge University Press,

New York, ISBN-10 0-521-46826-4, 1995.
- Bacon M., Simm R., Redshaw T.: 3-D Seismic Interpretation, Cambridge University Press, Cambridge, ISBN 978 0 521 71066, 2003.
- Serra O.: Well Logging and Reservoir Evaluation, Technip, Paris, ISBN 978-2-7108-0881-7, 2007
- D. V. Ellis, J. M. Singer, 2007: Well logging for earth scientists. Springer, Dordrecht, The Netherlands, ISBN 978-1-4020-3738-2 (HB).
- O. Serra, L. Serra, 2004: Data Acquisition and Applications, Editions Serralog, France, ISBN: 978295156125
- M. Rider, 1986. The geological interpretation of well logs. 2nd edition. Rider - French Consulting Ltd., Sutherland, Scotland, ISBN: 0-9541906-0-2.
- Schlumberger: Cased Hole Log Interpretation Principles/Applications, Schlumberger Educational Services, Houston, 1989
- James J. Smolen, Ph.D., 1996: Cased Hole and Production Log Evaluation, PennWell Publishing Co., Tulsa

Course Title: Oilfield Chemistry **Instructor:** Dr. István LAKATOS, professor emeritus	**Code:** MFKOT720011 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 1 (2)	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination / practical mark / other):** examination
Credits: 3	**Course:** full time

Course Description:

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

Competencies to evolve:
Knowledge: T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11
Ability: K1, K2, K3, K4, K5, K6, K7, K8, K11
Attitude:
Autonomy and responsibility: F1, F2, F3, F4, F5, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Midterm exam	40 %
Final exam	55 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

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

Course Title: Geothermal Energy **Instructor:** Dr. Anikó Nóra TÓTH, associate professor	**Code:** MFKGT740011 **Responsible department/institute:** DNGE/IPNG (GMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 1 (4)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 3	**Course:** full time

Course Description:

This is a graduate course covering the natural conditions, production and utilization, environmental impact of geothermal energy. The purpose of this course is to provide you with a broad understanding of these topics and their history, which will prove useful in other courses, your individual research, reading of the literature, and engineering practice. Information in this class can be applied prospecting and design of geothermal production technology and equipment together with the surface facilities of utilization. We will rely primarily on lectures and teamwork to develop your understanding of these principles. You will be expected to read and think about material outside class, and to take part actively in class discussions. These discussions will enhance the learning process, allow sharing of experiences, and hopefully make this course more interesting.

Competencies to evolve:
Knowledge: T1, T11
Ability: K1, K5, K6, K7, K8, K9, K10, K11
Attitude:
Autonomy and responsibility: F6, F7

Assessment and grading:	
Students will be assessed with using the following elements.	
Attendance:	5 %
Homework	10 %
Midterm exam	40 %
Final exam	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- A. Toth and E. Bobok: Flow and Heat Transfer in Geothermal Systems, Elsevier, Amsterdam, London, New York, Tokyo, 2016, ISBN: 9780128002773, 2016
- A. Toth: Heat Pumps, Digitalis jegyzet, Miskolci Egyetem, Miskolci Egyetem, 2014. http://www.tankonyvtar.hu/hu/
- A. Toth: Geothermal Direct Uses, Digitalis jegyzet, Miskolci Egyetem, Miskolci Egyetem, 2014. http://www.tankonyvtar.hu/hu/
- Ronald DiPippo: Geothermal Power Plants, Elsevier, 2013, ISBN: 978-0-08-098206-9
- R. Horne: Modern Well Test Analysis: A Computer-Aided Approach. Petroway, Inc., 1995, ISBN 0-9626992-1-7.
- J.W. Lund: Geothermal Direct-Use Engineering and Design Guidebook. Geo-Heat Center

Course Title: Petroleum Economics **Instructor:** Dr. Zsolt KOMLÓSI, honorary associate professor	**Code:** MFKOT720012 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 1 (4)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination / practical mark / other):** examination
Credits: 2	**Course:** full time

Course Description:

1. Brief summary of some general economic issues in macro-economics, micro-economics,
2. Brief summary of some general economic issues in company management (Porter's model) and decision theory.
3. Basis of economic approach including cash flow modeling, time preference (concept of compound interest and present value).
4. Forecast of key factors determining E&P business in the future.
5. Methods determining key economic indicators.
6. Features of appraisal individual projects applying economic indicators and their constraints in risk-free case.
7. Basic geological, technical and economical features of petroleum industry investment in case of exploration, field development (risks, resources, reserves, venture capital).
8. Basic geological, technical and economical features of production and abandonment (risks, resources, reserves, venture capital).
9. Crude oil and natural gas price history and price forecasting models.
10. Risks "measurements" and their impact on project value (expected value concept, Monte Carlo simulation).
11. Evaluation uncertainty and risk of various parameter estimates and their impact on (economic) indicators calculated.
12. Non-quantifiable (risk) factors and their impact on project evaluation.
13. Assessment of project groups (portfolio evaluation).
14. 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.

Competencies to evolve:
Knowledge: T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11
Ability: K1, K2, K3, K4, K5, K6, K7, K8, K9, K10, K11
Attitude:A1, A2, A3, A4, A5, A6, A7, A8
Autonomy and responsibility: F1, F2, F3, F4, F5, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Final exam	95 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Seba, R.D. (1998): Economics of Worldwide Petroleum Production. OGCI Publications Tulsa, p.582
- Megill, R.E. (1984): An Introduction to Risk Analysis. 2. Ed., PennWell Books Tulsa, p.274.
- Brealey/Mayers (2003): Principles of Corporate Finance, McGraw-Hill ISBN: 0072467665
- D. Johnston (1992): Oil Company Financial Analysis in Nontechnical Language (Pennwell Nontechnical Series)
- SPE (2007): Petroleum Resources Management System http://www.spe.org/industry/reserves/docs/Petroleum_Resources_Management_System_2007.pdf

Course Title: HSE in Petroleum Engineering **Instructor:** Dr. Tibor SZABÓ, associate professor	**Code:** MFKOT71011 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 1 (2)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination / practical mark / other):** examination
Credits: 3	**Course:** full time

Course Description:

1. Basics of fire and explosion protection.
2. Fundamentals of combustion theories.
3. Fundamentals of burnings of different materials, auto ignitions.
4. Fire protection.
5. Safety aspects of pressure vessels.
6. Safety aspects of bottles and other equipment.
7. Safety aspects of machines and processes: safety devices, safety questions of settlements and operating.
8. Chemicals safety.
9. Personal protective equipment.
10. Legal background and regulations of labors safety.
11. Requirements for healthy and safe working.
12. Objective and personal conditions of working.
13. Special requirements of processes.
14. The most important rights and duties of employees and employers

Competencies to evolve:
Knowledge: T1, T2, T3, T4, T5
Ability: K1, K3, K4, K9, K11
Attitude: A8
Autonomy and responsibility: F1, F2, F6, F7

Assessment and grading:
Students will be assessed with using the following elements.

Attendance:	5 %
Midterm exam	40 %
Final exam	55 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Design of plant, equipment and workplaces. Dangerous Substances and Explosives Regulations, 2003. ISBN 978 0 7176 2199 6
- Storage of dangerous substances/ Dangerous Substances and Explosive Regulations, 2003. ISBN 978 0 7176 2200 9.
- Dangerous Substances and Explosive Atmospheres Dangerous Substances and Explosive Atmospheres Regulations, 2003. ISBN 978 0 7176 2203 0
- Manufacture and Storage of Explosives Regulations, 2005. ISBN 978 0 7176 2816 2
- Stephen M. Testa, James A. Jacobs: Oil spills & gas leaks – Environmental Response, Prevention, and Cost Recovery, McGraw-Hill Education; 1 edition (March 31, 2014), ISBN: 978-0071772891

Course Title: Compulsory elective I. Gas Processing **Instructor:** Dr. Zoltán TURZÓ, associate professor László KIS, assistant lecturer	**Code:** MFKOT77003 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory Elective**
Position in curriculum* (which semester): 1 (4)	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 2	**Course:** full time

Course Description:

1. Gas laws
2. Equation of states and their usage.
3. Physical properties of hydrocarbon systems.
4. Vapor-liquid equilibrium calculations.
5. Gas hydrates and their formation.
6. Basics of separation,
7. Basics of separator types, separator design.
8. Absorption gas drier and treating system.
9. Adsorption technology.
10. Cold separation.
11. Computer modelling of gas treating technologies.

Competencies to evolve:
Knowledge: T1, T4, T5, T11
Ability: K1, K4, K5, K9, K10, K11
Attitude:
Autonomy and responsibility: F1, F3, F6, F7

Assessment and grading:
Students will be assessed with using the following elements.

Attendance:	5 %
Homework	10 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- J. M. Campbell (2014): Gas Conditioning and Processing, Vol. 1.: The Basic Principles, 9th edition, ISBN 978-0-9703449-2-2
- J. M. Campbell (2014): Gas Conditioning and Processing, Vol. 2.: The Equipment Modules, ISBN 978-0-9703449-5-3
- R. N. Maddox, D. J. Morgan (2006): Gas Conditioning and Processing, Vol. 4.: Gas Treating and Sulphur Recovery, ISBN 978-0-9703449-3-7
- F. S. Manning, R. E. Thompson (1991): Oilfield Processing of Petroleum, Volume 1.: Natural Gas, ISBN 978-0-87814-343-6
- A. Bahadori: Natural Gas Processing: Technology and Engineering Design, Gulf Professional Publishing, 2014. ISBN 9780124202047

Course Title: Compulsory electives II. Hydrogeology **Instructor:** Dr. Péter SZŰCS, professor	**Code:** MFKHT730017 **Responsible department/institute: KGI** **Course Element: Compulsory Elective**
Position in curriculum (which semester): 1(2)	**Pre-requisites (if any):**
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination / practical mark / other):** examination
Credits: 2	**Course:** full time

Course Description:

1. The main properties and quality aspects of groundwater.
2. Classification of groundwater resources.
3. Storage and hydraulic properties.
4. Darcy-law, flow and seepage equations.
5. Temperature properties under the surface.
6. Shallow and deep groundwater.
7. Karst water, river bank filtered water resources.
8. Relationship between groundwater and surface water.
9. Springs. Flow systems under the surface.
10. Groundwater as a geologic agent.
11. Determination of hydraulic conductivity.
12. Transport processes in groundwater.
13. Basics of well hydraulics.
14. Calculation of well discharge, determination of depression curve and velocity distribution around wells.

problems. Knowledge: T6, T7, T8
Ability:
Attitude:
Autonomy and responsibility: F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	15 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Péter Szűcs: Hydrogeology. Course materail for Geothermal engineers. University of Miskolc, 2011.
- Freeze, R. Allan, Cherry, John A.: Groundwater, Practice Hall Inc. 1979. 604 p. ISBN 0-13-365312-9
- Fetter, C. W.: Applied Hydrogeology, Practice Hall Inc., 2000. 597 p. ISBN 0-13-088239-9
- József Tóth: Gravitational Systems of Groundwater Flow. Cambridge University Press, 2009. 297 p. ISBN-13 978-0-521-88638-3
- Poehls, D.J. Smith, Gregory J.: Encyclopedic Dictionary of Hydrogeology. Elsevier Inc. 2009. 517 p. ISBN: 978-0-12-558690-0

Course Title: Compulsory Electives II.: Geothermal Well Drilling **Instructor:** Dr. Imre FEDERER, honor associate professor	**Code:** MFKOT730025 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory Elective**
Position in curriculum* (which semester): 1 (2)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination / practical mark / other):** examination
Credits: 2	**Course:** full time

Course Description:

1. The Geothermal drilling process.
2. The special drill string elements and drill string design, drill string loadings, drill bit selection for Geothermal Well Drilling.
3. Specialties in drilling mud engineering, and rig hydraulics.
4. Determination of fracturing gradient, casing shoe selection
5. Casing design, factors affecting casing.
6. Biaxial forces determination in casing design, bending forces.
7. Running casing operations.
8. Unscheduled event during drilling operation.
9. Wellbore stability, determination of rock properties, stress distribution around the wellbore.
10. Preventing borehole instability.
11. Primary cementing design, selection of cement and additives.
12. Cement slurry lab test, cementing calculations, effective mud removal.
13. Elements of well costing and affecting for well costing.
14. Drilling time estimate, drilling risk estimates, contracting strategies.

Competencies to evolve:
Knowledge: T1, T2, T3, T11
Ability: K1, K2, K3, K11
Attitude:
Autonomy and responsibility: F1, F2, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Homework	10 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

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

- Drilling Data Handbook, Edítion Technip, Paris ISBN 2-2108-0756-4, 1999. 542 p.
- Erik B. Nelson: Well Cementing. Schlumberger Educational Services. Second Edition, Houston Texas, 2006.
- R. DiPippo: Geothermal Power Plants, Butterworth-Heinemann 2012.

Course Title: Free elective Process Simulation Using ASPEN HYSYS **Instructor:** Dr. Zoltán TURZÓ associate professor László KIS, assistant lecturer	**Code:** MFKOT710021 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Free Elective**
Position in curriculum* (which semester): 1 (4)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 2+0	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 2	**Course:** full time

Course Description:

1. The Aspen HYSYS software package, its features, its applications, and the problems that can be solved.
2. Examination of elements suitable for production oil and natural gas: pipelines
3. Heat exchangers
4. Compressors
5. Expanders
6. Separators
7. Mixers
8. Production systems
9. Modeling of the technological sub-processes used to produce crude oil
10. Modeling of the technological sub-processes used to produce natural gas
11. Modeling of the technological sub-processes used during pipeline transport.
12. Evaluation of simulation results.
13. Structure of the cold separation technology model relating to the natural gas preparation, uploading, running and evaluation of data.
14. Compilation of documentation to solve the problem.

Competencies to evolve:
Knowledge: T1, T4, T5, T11
Ability: K1, K4, K5, K9, K10, K11
Attitude:
Autonomy and responsibility: F1, F3, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Homework	10 %
Midterm exam	40 %
Final exam	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- User Manuals of ASPEN HYSYS Software
- R. N. Maddox, D. J. Morgan: Gas Conditioning and Processing: Volume 4: Gas Treating and Sulfur Recovery, Campbell Petroleum Series, 2008
- F. S. Manning, R. E. Thompson: Oilfield Processing: volume Two: Crude Oil, PenWell, 1995.

- Gas Conditioning and Processing: Volume 2: Equipment Modules, Campbell Petroleum Series, 2013
- A. Bahadori: Natural Gas Processing: Technology and Engineering Design, Gulf Professional Publishing, 2014. ISBN 9780124202047

Course Title: Computer Applications II. **Instructor:** Dr. Zoltán TURZÓ associate professor	**Code:** MFKOT720021 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 1 (2)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 0+3	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 3	**Course:** full time

Course Description:

1. Database management using Microsoft Access: user interface, elements of databases, relational databases.
2. Creation of queries and reports.
3. Database maintenance.
4. General descriptions of CAD programs.
5. Creation of simple engineering drawings using AutoCAD: user interface
6. Creation of simple engineering drawings using AutoCAD: drawings up to scale
7. Creation of simple engineering drawings using AutoCAD: drawing elements.
8. Three-dimensional drawings.
9. General descriptions of mathematical programs.
10. Usage of MathCAD program: simple calculations.
11. Usage of MathCAD program: graphics, matrix operations,
12. Usage of MathCAD program: processing and analyzing measured data,
13. Usage of MathCAD program: programming,
14. Usage of MathCAD program: integral and differential calculations

Competencies to evolve:
Knowledge: T1, T8, T11
Ability: K1, K4, K5, K6, K7, K8, K11
Attitude:
Autonomy and responsibility:

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Homework	20 %
Midterm exam	30 %
Final exam	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- User manual of Microsoft Excel
- User manual of Visual Basic
- User manual of Microsoft Access
- User manual of the AutoCad
- User manual of MathCad

Course Title: Graduate Research Seminar **Instructor:** Dr. Ferenc MÁDAI associate professor	**Code:** MFFAT720007 **Responsible department/institute:** MFAKT **Course Element: Compulsory**
Position in curriculum* (which semester): 2 (1)	**Pre-requisites (if any):** -
No. of contact hours per week (lecture + seminar): 2+2	**Type of Assessment (examination / practical mark / other):** examination
Credits: 6	**Course:** full time

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 Description:

1. Editorial and formal requirements of scientific publications.
2. Editorial and formal requirements of scientific publications.
3. Planning of the concept and structure of a scientific publication, making an outline, development of a concept map.
4. Planning of the concept and structure of a scientific publication, making an outline, development of a concept map.
5. Usage of references, reference styles.
6. Etics of scientific writing: how to avoid plagiarism, usage of citations.
7. Information sources provided by the Central Library: hard copy, catalogue search, electronic resources.
8. Information sources provided by the Central Library: hard copy, catalogue search, electronic resources.
9. Usage of electronic information resources: search options, simple and combined search, electronic libraries.
10. Data visualization: graphs, figures, tables.
11. Data visualization: graphs, figures, tables.
12. The art of presentation: preparation for an oral contribution.
13. The art of presentation: preparation for an oral contribution.
14. The art of presentation: preparation of a poster.

Competencies to evolve:
Knowledge: T1, T2, T3, T11
Ability: K1, K2, K3, K5, K6, K7, K8, K9, K10, K11
Attitude: A2, A3, A4, A5, A6, A7, A8, A9
Autonomy and responsibility: F1, F2, F3, F4, F5

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 topic in 10 minutes (25%).

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

Compulsory or recommended literature resources:

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

<table>
<tr><td>Course Title: Drilling Engineering I.
Instructor: Dr. Tibor SZABÓ associate professor</td><td>Code: MFKOT720022
Responsible department/institute:
DPE/IPNG (OMTSZ/KFGI)
Course Element: Compulsory</td></tr>
<tr><td>Position in curriculum*
(which semester): 2 (1)</td><td>Pre-requisites (if any): -</td></tr>
<tr><td>No. of contact hours per week (lecture + seminar): 2+2</td><td>Type of Assessment (examination / practical mark / other): examination</td></tr>
<tr><td>Credits: 6</td><td>Course: full time</td></tr>
<tr><td colspan="2">Course Description:
15. The drilling process, unit systems pressure conditions in the borehole.
16. Metric unit system, field units. Conversion.
17. The drilling rig.
18. Well structure. Casing shoe setting depth determination.
19. Formation integrity tests.
20. The drill string: components, design.
21. Drill bits: design and classification of roller and diamond bits.
22. Dull bit evaluation.
23. Kick tolerance & calculation.
24. Vertical and directional drilling & MWD,LWD
25. Deviated well path calculation.
26. Casing design.
27. Hole problems, stuck pipe, fishing.
28. Special services: coring, workover, slickline, coiled tubing, underbalanced drilling.
Competencies to evolve:
Knowledge: T1, T2, T3, T11
Ability: K1, K2, K3, K11
Attitude:
Autonomy and responsibility: F1, F2, F6, F7</td></tr>
<tr><td>Assessment and grading:
Signature requirements: The written tests will cover the course material reviewed till the test’s date. The total signature grade should be above 50% and min. 50 % is required in both tests to earn the signature. There is no possibility to improve the written tests. The signature grading is the following:
Attendance: 5 %
Homework 10 %
Midterm exam 40 %
Final exam 45 %
Total 100%</td><td>Grades: The grading depends on the oral exam’s result however some extra bonuses can be earned in the semester. The bonus system is the following:
<table><tr><th>Signature grade</th><th>Bonus</th></tr><tr><td>91% or above</td><td>offered a 5, excellent grade</td></tr><tr><td>76% to 90%</td><td>+ 1 grade at the oral exam</td></tr><tr><td>75% or below</td><td>no effect on the oral exam’s result</td></tr></table></td></tr>
</table>

Compulsory or recommended literature resources:

- H. Rabia: Oilwell Drilling Engineering. Principles and Practice. Graham Tratman Ltd. London 1995. 322 p.
- Howard B. Bradley: Petroleum Engineering Handbook, Third Printing, Society of Petroleum Engineers, Richardson, TX, U.S.A. 1992.
- Drilling Data Handbook, Edition Technip, Paris ISBN 2-2108-0756-4, 1999. 542 p.
- Erik B. Nelson: Well Cementing. Schlumberger Educational Services. Second Edition, Houston Texas, 2006
- H. Dale Beggs: Gas production operation. OGCI Publications, Tulsa, 1984.
- Arthur Lubinski (Edited by Stefan Miska): Development of Petroleum Engineering I-II. Gulf Publishing Company, Houston, 1987.

Course Title: Well Control Lab. **Instructor:** Dr. Tibor SZABÓ associate professor	**Code:** MFKOT730014 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 2 (3)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 0+3	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 3	**Course:** full time

Course Description:

1. Causes of kicks, warning signs of kicks
2. Pressure balance in the hole
3. Behavior of gas in the well
4. Shutting-in procedures
5. Shallow gas problems
6. Stripping operation
7. Well control methods: Driller's method
8. Well control methods: Wait & Weight method
9. Well control equipment
10. BOP stack arrangements
11. Manifolds and valves systems, other devices
12. Accumulator units
13. Pressure testing of well control equipment
14. Regulations and standards.

Competencies to evolve:
Knowledge: T1, T2, T3, T11
Ability: K1, K6, K7, K8, K11
Attitude:
Autonomy and responsibility: F1, F2, F6, F7

Assessment and grading:
Students will be assessed with using the following elements.

Attendance	10 %
Final Test	45 %
Practical Test	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

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

Course Title: Production Engineering Fundamentals **Instructor:** Dr. Gábor TAKÁCS, professor emeritus	**Code:** MFKOT720025 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 2 (1)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 2+2	**Type of Assessment (examination / practical mark / other):** examination
Credits: 6	**Course:** full time

Course Description:

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

Competencies to evolve:
Knowledge: T1, T4, T5, T11
Ability: K1, K4, K5, K9, K10, K11
Attitude:
Autonomy and responsibility: F1, F3, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Homework	10 %
Midterm exam	40 %
Final exam	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- A.P. Szilas: Production and Transport of Oil and Gas. Part A., Akadémiai Kiadó, Budapest, 1986.
- Takács G.: Fundamentals of Production Engineering. okt. segédlet, Miskolci Egyetem, 2005, 161p.
- G. Takács: Gas Lift Manual., PennWell Corporation, Tulsa, USA. 2005. 478p, ISBN 0-87814-805-1.
- George V.Chilingarian et.al.: Surface Operations in Petroleum Production II, Elsevier, 1989
- Larry W. Lace: General Engineering, Petroleum Engineering Handbook Vol 1, SPE, 2006

Course Title: Artificial Lifting I **Instructor:** Dr. Gábor TAKÁCS professor emeritus	**Code:** MFKOT720017 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 3 (2)	**Pre-requisites (if any):** Production engineering fundamentals (MFKOT720025)
No. of contact hours per week (lecture + seminar): 2+2	**Type of Assessment (examination / practical mark / other):** examination
Credits: 6	**Course:** full time

Course Description:

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

Competencies to evolve:
Knowledge: T1, T4, T5, T11
Ability: K1, K4, K5, K9, K10, K11
Attitude:
Autonomy and responsibility: F1, F3, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Homework	10 %
Midterm exam	40 %
Final exam	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Takács G.: Basic sucker rod pumping. Miskolc, ME, 1992. 321 p.
- Takács G.: Sucker-rod pumping manual. Tulsa : PennWell, 2003. 395 p. ISBN 0 87814 899 2
- G. Takács: Modern sucker-rod pumping. Tulsa : PennWell, 1993. 230 p. ISBN 0 87814 383 1
- Production Operations Engineering, Petroleum Engineering Handbook Vol 4, SPE, 2006
- George V.Chilingarian et.al.: Surface Operations in Petroleum Production II, Elsevier, 1989.

Szilas, A.P.: Production and Transport of Oil and Gas. Part B., Akadémiai Kiadó, Budapest, 1986., ISBN 963-05-3363-4

<table>
<tr><td>Course Title: Reservoir Engineering Fundamentals
Instructor: Dr. Gabriella FEDERER KOVÁCSNÉ assistant professor</td><td>Code: MFKOT720024
Responsible department/institute: DPE/IPNG (OMTSZ/KFGI)
Course Element: Compulsory</td></tr>
<tr><td>Position in curriculum*
(which semester): 2 (1)</td><td>Pre-requisites (if any): no</td></tr>
<tr><td>No. of contact hours per week (lecture + seminar): 2+2</td><td>Type of Assessment (examination / practical mark / other): examination</td></tr>
<tr><td>Credits: 6</td><td>Course: full time</td></tr>
<tr><td colspan="2">Course Description:
1. Fundamental properties of porous media.
2. Porosity, Compressibility, Specific surface area.
3. Saturation.
4. Wettability and determination of capillary pressure.
5. Determination of the permeability of a porous media.
6. Determination of the two-phase and relative permeability.
7. Electric properties and the tortuosity of a porous rock.
8. Equations of state.
9. PVT correlation for natural gases.
10. PVT correlation for saturated black oils.
11. PVT correlation for under saturated black oils.
12. Equilibrium calculation of two phase hydrocarbon systems.
13. PVT correlations for water.
14. Viscosity correlations for petroleum reservoir fluids.
Competencies to evolve:
Knowledge: T1, T6, T7, T8, T11
Ability: K1, K6, K7, K8, K11
Attitude:
Autonomy and responsibility: F1, F4, F6, F7</td></tr>
<tr><td>Assessment and grading:
Students will be assessed with using the following elements.
Attendance: 5 %
Homework 10 %
Midterm exam 40 %
Final exam 45 %
Total 100%</td><td>Grading scale:
% value Grade
90 -100% 5 (excellent)
80 – 89% 4 (good)
70 - 79% 3 (satisfactory)
60 - 69% 2 (pass)
0 - 59% 1 (failed)</td></tr>
</table>

Compulsory or recommended literature resources:

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

János Török, Lipót Fürcht, Tibor Bódi: PVT Properties of Reservoir Fluids. (Book). University of Miskolc Miskolc, Hungary 2012. ISBN 978-963-661-988-5 p. 1-192

Course Title: Fluid Mechanics **Instructor:** Dr. Anikó Nóra TÓTH associate professor László KIS assistant lecturer	**Code:** MFKGT710005 **Responsible department/institute:** DNGE/IPNG (GMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 2 (1)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 3+0	**Type of Assessment (examination / practical mark / other):** examination
Credits: 3	**Course:** full time

Course Description:

1. Kinematics.
2. Conservation of mass.
3. Balance Equations of momentum.
4. Perfect Fluid Flow.
5. Euler's equation.
6. Bernoulli's equation.
7. Elements of gas dynamics.
8. Bernoulli equation with friction.
9. Laminar and turbulent flow in pipes.
10. Determination of pressure losses.
11. Moody's diagram.
12. Pressure losses in gas transporting pipe-lines.
13. Pressure losses in liquid transporting pipe-lines.
14. Non-isothermal losses in transporting pipe-lines

Competencies to evolve:
Knowledge: T2, T3, T6, T7, T8, T9, T10
Ability: K1, K4, K5, K6, K7, K8, K9, K10, K11
Attitude:
Autonomy and responsibility: F1, F2, F3, F4, F5, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Homework	10 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- E. Bobok: Fluid Mechanics for Petroleum Engineers. Elsevier, Amsterdam, London, New York, Tokyo, 1993. ISBN: 10: 0-444-98668-5
- V. L. Streeter, E. B. Wylie, K. W. Bedford: Fluid Mechanics. WCB/McGraw-Hill 1998, ISBN 0-07-062537-9
- R. Bird, W. Stewart, E. Lightfoot: Transport Phenomena. John Wiley and Sons, New York, 2007. ISBN: 978-0-470-11539-8
- Bobok E.: Fluid Mechanics. 2013.
- Streeter W. et. al: Fluid Mechanics, Auckland: McGraw-Hill, 1983.

Course Title: Drilling Engineering II. **Instructor:** Dr. Tibor SZABÓ associate professor	**Code:** MFKOT730033 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 3 (2)	**Pre-requisites (if any):** Drilling engineering I. (MFKOT720022)
No. of contact hours per week (lecture + seminar): 2+2	**Type of Assessment (examination / practical mark / other):** examination
Credits: 5	**Course:** full time

Course Description:

1. Wellbore stability.
2. Determination of rock properties, stress distribution around the wellbore, preventing borehole instability.
3. Primary cementing design, selection of cement and additives.
4. Cement slurry lab test, cementing calculations, effective mud removal.
5. Surface equipment and subsurface tools of cementing operation,
6. Two stage cementing operation.
7. Liner cementing, squeeze cement operation.
8. Cement job evaluation, foam cement applications.
9. Managed pressure drilling technology and surface equipment.
10. Mud logging.
11. Elements of well costing and affecting for well costing.
12. Drilling time estimation.
13. Drilling risk estimates.
14. Contracting strategies.

Competencies to evolve:
Knowledge: T1, T2, T3, T11
Ability: K1, K2, K3, K11
Attitude:
Autonomy and responsibility: F1, F2, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Homework	10 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	35 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- H. Rabia: Oilwell Drilling Engineering. Principles and Practice. Graham Tratman Ltd. London 1995. 322 p.
- Howard B. Bradley: Petroleum Engineering Handbook, Third Printing, Society of Petroleum Engineers, Richardson, TX, U.S.A. 1992.
- Drilling Data Handbook, Edition Technip, Paris ISBN 2-2108-0756-4, 1999. 542 p.
- Erik B. Nelson: Well Cementing. Schlumberger Educational Services. Second Edition, Houston Texas, 2006.
- Arthur Lubinski (Edited by Stefan Miska): Development of Petroleum Engineering I-II. Gulf Publishing Company, Houston, 1987.

Course Title: Artificial Lifting II. **Instructor:** Dr. Gábor TAKÁCS professor emeritus	**Code:** MFKOT730031 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 4 (3)	**Pre-requisites (if any):** Artificial lifting I. (MFKOT720017)
No. of contact hours per week (lecture + seminar): 3+0	**Type of Assessment (examination / practical mark / other):** examination
Credits: 3	**Course:** full time

Course Description:

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

Competencies to evolve:
Knowledge: T1, T4, T5, T11
Ability: K1, K4, K5, K9, K10, K11
Attitude:
Autonomy and responsibility: F1, F3, F6, F7

Assessment and grading:
Students will be assessed with using the following elements.

Attendance:	5 %
Short quizzes	10 %
Midterm exam	40 %
Final exam	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Cholet, H.: Progressing cavity pumps. Editions Technip, Paris. 1997. 112p. ISBN 2-7108-0724-6.
- G Takacs.: Sucker-rod pumping manual. Tulsa : PennWell, 2003. 395 p. ISBN 0 87814 899 2
- Production Operations Engineering, Petroleum Engineering Handbook Vol 4, SPE, 2006
- George V. Chilingarian et.al.: Surface Operations in Petroleum Production II, Elsevier, 1989.
- Szilas, A.P.: Production and Transport of Oil and Gas. Part B., Akadémiai Kiadó, Budapest, 1986., ISBN 963-05-3363-4

Takács G.: Production technology 2. Univ. of Miskolc, 1991. 216p.

Course Title: Flow in Porous Media **Instructor:** Dr. Zoltán TURZÓ associate professor	**Code:** MFKOT730035 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 3 (2)	**Pre-requisites (if any):** Reservoir Engineering Fundamentals (MFKOT720024)
No. of contact hours per week (lecture + seminar): 0+3	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 3	**Course:** full time

Course Description:

1. Equation of single phase filtration.
2. Solution of the equation of single phase filtration.
3. Piston-like displacement.
4. Characteristics of various flow regimes, steady-state flow, unsteady-state flow, pseudo steady-state slow
5. The radial-diffusivity equation, solutions to the radial-diffusivity, equation bounded cylindrical reservoir, infinite cylindrical reservoir with line source, well pseudo steady-state flow, choosing the best pressure functions
6. Principle of superposition accounting for the effects of more than one well, accounting for rate change effects, accounting for pressure change effects simulating boundary effects.
7. The equation of two phase filtration, vertical two-phase filtration of incompressible fluids, the fractional flow equation, frontal displacement determination of the frontal saturation by material balance method.
8. Water coning, fingering and cresting in vertical and horizontal wells, critical rate calculation.
9. Steady state and pseudo-steady state filtration around horizontal well.
10. Water and gas coning in horizontal wells
11. Well Tests: flow tests
12. Well Tests: Pressure Build-up Tests (PBUPT)
13. Well Tests: Interpretations of PBUPT
14. Well Tests: Interpretations of PBUPT

Competencies to evolve
Knowledge: T1, T6, T7, T8, T11
Ability:K1, K6,K7,K8, K11
Attitude:
Autonomy and responsibility: F1, F4, F6, F7

Assessment and grading:	
Students will be assessed with using the following elements.	
Attendance:	5 %
Midterm exam	40 %
Final exam	55 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

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

Course Title: Material Balance **Instructor:** Dr. Gabriella FEDERER KOVÁCSNÉ assistant professor	**Code:** MFKOT730026 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 3 (2)	**Pre-requisites (if any):** Reservoir Engineering Fundamentals (MFKOT720024)
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination / practical mark / other):** examination
Credits: 3	**Course:** full time

Course Description:

1. Basic terms, conditions.
2. Different forms of the material balance equation.
3. Material Balance of the saturated oil reservoir and under saturated oil reservoir.
4. Average pressure.
5. Drive mechanics, drive indices.
6. Material balance equation of a gas reservoir.
7. Water influx.
8. Volumetric and open reservoirs.
9. Van Everdingen and Hurst method for water influx determination.
10. Fetkovich method for water influx determination.
11. Plots used to determine OOIP and OGIP for gas and oil reservoirs.
12. Hydrocarbon in Place Estimation with material balance.
13. Havlena-Odeh, Schilthuis, Tarner, Tehrani, Sills methods.
14. Prediction with material balance.

Competencies to evolve:
Knowledge: T1, T6, T7, T8, T11
Ability: K1, K6, K7, K8, K11
Attitude:
Autonomy and responsibility: F1, F4, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Homework	10 %
Midterm exam	40 %
Final exam	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- J. Pápay: Development of Petroleum Reservoirs, Akadémiai Kiadó, Budapest 2003. ISBN 963 05 7927 8
- Craft and Hawkins: Applied Petroleum Reservoir Engineering, Prentice Hall, 1991, ISBN 0-13-039884-5
- Towler: Fundamental Principles of Reservoir Engineering, SPE Textbook Series, Vol.8., 2002, ISBN 1-55563-092-8
- T. Ahmed: Advanced Reservoir Engineering, Gulf Publishing Co. 2005, ISBN-13: 978-0-7506-7733-2
- T. Ahmed: Reservoir Engineering Handbook, Gulf Publishing Co., 2001, ISBN 0-88415-770-9

L.P.Dake: Fundamentals of Reservoir Engineering, Elsevier, 1978, ISBN 0-444-41830-X

Course Title: Transport of Hydrocarbons **Instructor:** Dr. Zoltán TURZÓ associate professor László KIS assistant lecturer	**Code:** MFKOT730036 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 2 (1)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 0+2	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 2	**Course:** full time

Course Description:

1. Hydraulics: Pressure drop in liquid.
2. Hydraulics: Pressure drop in liquid.
3. Hydraulics: gas carrying pipelines.
4. Hydraulics: gas carrying pipelines.
5. Thermodynamics: Temperature of oil in buried pipeline.
6. Pressure loss calculation.
7. Pipeline engineering: Determination of pipe diameters and thickness.
8. Parallel lines, booster pumps.
9. Pipeline construction.
10. Centrifugal pumps and gas compressors: Series and parallel pumps.
11. Centrifugal pumps and gas compressors: characteristic curves, control.
12. Instrumentation: Pipeline and metering station instrumentation.
13. Maintenance: Pipeline inspection and repairs, limits of imperfection.
14. MAOP calculation.

Competencies to evolve:
Knowledge: T1, T4, T5, T9, T10, T11
Ability: K1, K9, K10, K11
Attitude:
Autonomy and responsibility: F1, F5, F6, F7

Assessment and grading:
Students will be assessed with using the following elements.

Attendance:	5 %
Homework	10 %
Midterm exam	40 %
Final exam	45 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Szilas, A.P.: Production and Transport of Oil and Gas. Part A., Akadémiai Kiadó, Budapest, 1986., ISBN 963-05-3363-4
- Szilas, A.P.: Production and Transport of Oil and Gas. Part B., Akadémiai Kiadó, Budapest, 1986., ISBN 963-05-3938-1
- Kennedy, J. L.: Oil and Gas Pipeline Fundamentals, 1993. Penn Well Books. ISBN 0-87814-390-4
- J. N. H. Tiratsoo: Pipeline Pigging Technology, 1998. Gulf Professional Publishing ISBN 0-87201-426-6
- E. L. Upp: Fluid Flow Measurement, 1993. Gulf Professional Publishing ISBN 0-88415-017-8

<table>
<tr><td>Course Title: Well Completion Design
Instructor: Dr. Tibor SZABÓ associate professor</td><td>Code: MFKOT720014
Responsible department/institute:
DPE/IPNG (OMTSZ/KFGI)
Course Element: Compulsory</td></tr>
<tr><td>Position in curriculum*
(which semester): 4 (3)</td><td>Pre-requisites (if any): Drilling Engineering I. (MFKOT720022)</td></tr>
<tr><td>No. of contact hours per week (lecture + seminar): 2+1</td><td>Type of Assessment (examination / practical mark / other): examination</td></tr>
<tr><td>Credits: 3</td><td>Course: full time</td></tr>
<tr><td colspan="2">Course Description:
1. Tubing string design.
2. Recommended torque for threaded coupling.
3. Tubing elongation, tubing movements.
4. Introduction of packer types.
5. Calculation of packer forces.
6. Connection between tubing and packer.
7. Well completion tools selection.
8. Perforating techniques, control the formation damage.
9. Well completion fluids.
10. Gravel pack techniques.
11. Formation stimulation: hydraulic fracturing
12. Formation stimulation: matrix acidizing,
13. Coiled tubing operations, wireline operations, nitrogen operations,
14. Well completion quality control.
Competencies to evolve:
Knowledge: T1, T2, T3, T11
Ability: K1, K2, K3, K4, K5, K11
Attitude:
Autonomy and responsibility: F1, F2, F3, F4, F7</td></tr>
<tr><td>Assessment and grading:
Students will be assessed with using the following elements.
Attendance: 5 %
Homework 10 %
Midterm exam 40 %
Final exam 45 %
Total 100%</td><td>Grading scale:
% value Grade
90 -100% 5 (excellent)
80 – 89% 4 (good)
70 - 79% 3 (satisfactory)
60 - 69% 2 (pass)
0 - 59% 1 (failed)</td></tr>
</table>

Compulsory or recommended literature resources:

- H. Rabia: Oilwell Drilling Engineering. Principles and Practice. Graham Tratman Ltd. London 1995. 322 p.
- Howard B. Bradley: Petroleum Engineering Handbook, Third Printing, Society of Petroleum Engineers, Richardson, TX, U.S.A. 1992.
- Drilling Data Handbook, Edítion Technip, Paris ISBN 2-2108-0756-4, 1999. 542 p.
- Erik B. Nelson: Well Cementing. Schlumberger Educational Services. Second Edition, Houston Texas, 2006.
- Arthur Lubinski (Edited by Stefan Miska): Development of Petroleum Engineering I-II. Gulf Publishing Company, Houston, 1987.

Course Title: NODAL Analysis Applications **Instructor:** Dr. Zoltán TURZÓ associate professor	**Code:** MFKOT730016 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 4 (3)	**Pre-requisites (if any):** Production Engineering Fundamentals MFKOT720025
No. of contact hours per week (lecture + seminar): 0+2	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 2	**Course:** full time

Course Description:

1. General introduction of NODAL Analysis programs.
2. Building of the NODAL Analysis model.
3. Testing of the model using field data.
4. Using of the model for inspection, optimization.
5. Using of the model for design.
6. Connection to other simulators.
7. Nodal Analysis of flowing wells: oil wells
8. Nodal Analysis of flowing wells: gas wells
9. Nodal Analysis of flowing wells: multilateral wells
10. Nodal Analysis of gas lifted wells.
11. Nodal Analysis of sucker rod pumped wells.
12. Nodal Analysis of ESP wells.
13. Nodal Analysis of PCP wells.
14. Simulation and optimization of networks and gathering systems.

Competencies to evolve:
Knowledge: T1, T4, T5, T6, T7, T8, T10, T11
Ability: K1, K4, K5, K6, K7, K8, K9, K10, K11
Attitude:
Autonomy and responsibility: F1, F3, F6, F7

Assessment and grading:
Students will be assessed with using the following elements.

Attendance:	5 %
Midterm exam	40 %
Final exam	55 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Beggs, H. D.: Production Optimization Using NODAL Analysis, OGCI Publications, 2003. ISBN: 0-930972-14-7
- Takács, G.: Gas Lift Manual., PennWell Corporation, Tulsa, USA. 2005. 478p, ISBN 0-87814-805-1.
- Takács, G.: Sucker-rod pumping manual. Tulsa : PennWell, 2003. 395 p. ISBN 0 87814 899 2
- Takács, G.: Electrical submersible pumps manual. Elsevier, 2009. 425 p. ISBN 978 1 85617 557 9.
- Cholet, H.: Progressing cavity pumps. Editions Technip, Paris. 1997. 112p. ISBN 2-7108-0724-6.

Course Title: Reservoir Management simulation lab. **Instructor:** Dr. Zoltán TURZÓ associate professor	**Code:** MFKOT730015 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 4 (3)	**Pre-requisites (if any):** Flow in Porous Media MFKOT730035
No. of contact hours per week (lecture + seminar): 0+3	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 3	**Course:** full time

Course Description:

1. Definition of reservoir management.
2. Short history.
3. Basics of reservoir management. Goals.
4. Realization.
5. Monitoring.
6. Evaluation.
7. Case studies.
8. Data acquisition and analysis.
9. Material Balance calculations.
10. Numerical simulation.
11. Economic considerations.
12. Risk analysis.
13. EOR methods.
14. Case studies

Competencies to evolve:
Knowledge: T1, T6, T7, T8, T11
Ability: K1, K6, K7, K8, K10, K11
Attitude:
Autonomy and responsibility: F1, F4, F6, F7

Assessment and grading:
Students will be assessed with using the following elements.

Attendance:	5 %
Midterm exam	40 %
Final exam	55 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

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

Course Title: EOR Methods **Instructor:** Dr. Federer Gabriella assistant professor	**Code:** MFKOT740013 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 4 (3)	**Pre-requisites (if any):** Flow in Porous Media (MFKOT730035)
No. of contact hours per week (lecture + seminar): 2+1	**Type of Assessment (examination / practical mark / other):** examination
Credits: 3	**Course:** full time

Course Description:

To teach students production procedures, methods producing hydrocarbon reservoirs with higher recovery factor (EOR, IOR). To prepare students for inter disciplinary sciences and how to apply them to oil reservoirs.

1. Hydrodynamic principles of oil displacement with miscible fluids.
2. Hydrodynamic principles of oil displacement with immiscible fluids.
3. Areal and edge flooding methods: well systems, displacement.
4. Areal and edge flooding methods: areal and vertical displacement.
5. Areal and edge flooding methods: volumetric efficiencies.
6. Enhanced Oil Recovery methods (EOR).
7. Oil displacement by CO2 injection.
8. Oil displacement by polymer flooding.
9. Oil displacement with tensides and with polymer-tensides.
10. Oil displacement with foam.
11. Thermal methods: in-situ combustion (wet combustion).
12. Thermal methods: hot water injection.
13. Thermal methods: steam injection.
14. Special displacement methods (heavy oil, bitumen production).

Competencies to evolve:
Knowledge: T1, T6, T7, T8, T11
Ability: K1, K6, K7, K8, K11
Attitude:
Autonomy and responsibility: F1, F4, F6, F7

Assessment and grading:

Students will be assessed with using the following elements.

Attendance:	5 %
Midterm exam	40 %
Final exam	55 %
Total	100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

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

Competency Codes

Knowledge		**T1**	Knows the economic processes related to the hydrocarbon industry.
		T2	Familiar with the equipment, methods and facilities necessary for drilling the oil, gas and water wells.
		T3	Familiar with the methods used to avoid and eliminate the typical disturbances when establishing oil, gas and water wells.
		T4	Familiar with the processes and phenomena involved in the production of oil, natural gas and water wells.
		T5	Knows the equipment used for production (natural flow and artificial) methods for selecting the necessary equipment and procedures.
		T6	Familiar with the characteristics of the fluids found in the petroleum, natural gas, geothermal reservoirs and the properties of the rocks and the characteristics of the flow in porous mediums.
		T7	Familiar with the production mechanisms of underground reservoirs and the primary or enhanced recovery methods for optimum output.
		T8	Knows the basics of numerical simulation of underground reservoirs.
		T9	Knows the equipment and procedures related to the transport of oil, gas and water through pipelines.
		T10	Knows the basics of design and operation of fluid transport in the field and through transfer lines.
		T11	Familiar with the methods and software of computer design and analysis in the hydrocarbon industry.
Ability		**K1**	Able to interpret the economic processes related to the hydrocarbon industry and give adequate answers to them.
		K2	Able to manage teams to operate the equipment needed for the drilling of oil, gas and water wells and to design drilling of wells.
		K3	Able to avoid disturbances that are typically encountered when establishing oil, gas and water wells.
		K4	Capable of tracing and forecasting processes occurring in oil, natural gas and water wells.
		K5	Capable of selecting the optimum production method, designing and selecting the production equipment.
		K6	Capable of forecasting the behavior of the fluids found in the petroleum, natural gas and geothermal reservoirs, the properties of the reservoir rocks and the characteristics of the seepage in the reservoirs.
		K7	Able to recognize the production mechanisms of underground reservoirs and to select the optimum of primary or enhanced recovery mechanisms.
		K8	Able to perform a numerical simulation of underground reservoirs.
		K9	Capable of monitoring and checking equipment related to the transport of oil, gas and water through pipelines.
		K10	Capable of selecting equipment for field and transfer line delivery of fluids and supervising equipment operation and managing the groups involved.
		K11	Capable to perform computer design and evaluations for hydrocarbon industry.
Attitude		**A1**	Enforce sustainability and energy efficiency requirements.
		A2	Strive professionally at a high level, independently or in a workgroup to plan and carry out tasks.
		A3	Strives to carry out work using a complex approach based on a systematic and process-oriented mindset.
		A4	Seeks to achieve research, development and innovation goals during work.
		A5	Open to self-cultivation and vocational training for self-improvement.
		A6	Dedicated to high quality working and will strive to convey this approach to the staff.
		A7	Has the appropriate motivation to carry out activities that often vary between work, geographic and cultural circumstances.
		A8	In the course of work, SHE or QA/QC (Safety, environmental protection and quality assurance and control) requirements are adhered to.
Responsibility		**F1**	Independently capable of manage a hydrocarbon industrial complex design work and the task of performing and participating in Project manager tasks.
		F2	Independently capable to design construction (drilling) and to manage drilling fluids, producing wells, to optimize the cost of deep drilling; to troubleshoot of breakdowns during drilling.
		F3	Autonomously capable to design the production of fluid producing wells, to achieve optimum production conditions; to select the necessary equipment and procedures.
		F4	Autonomously capable to choose the recovery mechanism of underground reservoirs; to select the most favorable reservoir management.
		F5	Self-able to design and operate fluid transport equipment.
		F6	Has an autonomous capacity to plan the use of renewable natural resources and from residues into the energy supply system, to operate the established system
		F7	Takes responsibility for professional decisions, for carrying out workflows or managing them.