APPLIED GEOPHYSICS

MS in Petroleum Engineering

Semester 1, 2020/21

COURSE COMMUNICATION FOLDER

University of Miskolc
Faculty of Earth Science and Engineering
Institute of Geophysics and Geoinformatics

Course datasheet

<table>
<tr><td rowspan="2">Course Title: Applied Geophysics
Instructor: Gábor Pethő Dr., private professor, Péter Vass Dr., associate professor</td><td>Code: MFFGT710005
Responsible department/institute: MFGFT</td></tr>
<tr><td>Type of course: C</td></tr>
<tr><td>Position in curriculum (which semester): 1</td><td>Pre-requisites (if any): -</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">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: the most important geophysical parameters used in HC exploration. Geophysical exploration (magnetic, gravity, electromagnetic, radiometry, geothermal) methods, their resolutions and their role in HC exploration. Seismic reflection method, corrections made on seismic data to gain seismic section in depth. VSP. Geophysical methods detecting HC in direct way (bright spot, AVO analysis). Time-lapse (including 4D) geophysical measurements. Physical bases and instrumentation of bore-hole geophysical measurements. The main features of wire line logging. The main features of logging while drilling and production well logging. The determination of porosity, permeability, water and HC saturation. Log indicators of over pressured zones. Technical measurements and their applications. Information gained by logging in cased holes. Detecting well problems. Application of logging in injection, production and monitoring wells. 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</td></tr>
<tr><td colspan="2">Assessment and grading:
Students will be assessed with using the following elements.
Attendance: 5 %, Assignments: 25 %, Midterm exam:20 %, Final exam:50 %
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>
<tr><td colspan="2">Compulsory or recommended literature resources:
• updated slide decks edited by the lecturers and converted in pdf format: http://geofizika.uni-miskolc.hu/education.html
• 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.
• D. V. Ellis, J. M. Singer, 2007: Well logging for earth scientists. Springer, Dordrecht,</td></tr>
</table>

The Netherlands, ISBN 978-1-4020-3738-2 (HB)
- O. Serra, L. Serra, 2004: Data Acquisition and Applications, Editions Serralog, France, ISBN: 978295156125
- 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

Syllabus of the semester

Date 2020	**Lecture**
Sept.7	The role of geophysics and well-logging in the course of the different phases of HC exploration. The most important rock physical parameters.
Sept.14	Surface geophysical methods of low resolution (gravity, magnetic, radiometric, geothermal). EM methods (MT, CSAMT, marine EM)
Sept.21	The role of potential geophysical method in HC exploration.
Sept.28	The physical principle of seismic methods, the instrumentation, conventional and vibroseis method.
Oct.5	Elastic waves velocities, densities characterizing different formations. Corrections made on seismic data to gain seismic section in depth, VSP
Oct.12	Corrections made on seismic data to gain seismic section in depth, VSP. Seismic reflection methods detecting HC in direct way (bright spot, AVO analysis)
Oct.19	Seismic reflection methods detecting HC in direct way (bright spot, AVO analysis). Time-lapse (including 4D) geophysical measurements.
Oct.26	The main features of wireline logging and logging while drilling. The main features of open-hole, cased-hole and production well logging. Physical bases and instrumentation of wireline logging operations.
Nov.2	Rectorial holiday (workday without education)
Nov.9	Physical bases and instrumentation of wireline logging operations. Effect of drilling mud on the borehole environment.
Nov.16	Conventional logging methods for lithology determination.
Nov.23	Conventional porosity logging methods.
Nov.30	Resistivity and conductivity measurements.
Dec.7	Other technical measurements, cased-hole and production well logging operations.

Date 2020	Seminar
Sept.7	Calculation of Bouguer anomaly map.
Sept.14	Calculation of heat flux gained by conduction and convection.
Sept.21	Calculation of acoustic impedances, reflection coefficients, arrival times.
Sept.28	Seismic assignments.
Oct.5	Test (open book or closed book depending on the type of questions)
Oct.12	On land and marine case histories showing the efficiency of the simultaneous application of different geophysical methods.
Oct.19	The main features of wireline logging and logging while drilling.
Oct.26	.The main features of open-hole, cased-hole and production well logging. Physical bases and instrumentation of wireline logging operations.
Nov.2	Rectorial holiday (workday without education)
Nov.9	Depth of investigation. Minimum bed resolution. Investigation geometry. Petrophysical model of reservoir rocks. Reservoir parameters.
Nov.16	Conventional logging methods for lithology determination.
Nov.23	Conventional porosity logging methods.
Nov.30	Resistivity and conductivity measurements.
Dec.7	Other technical measurements, cased-hole and production well logging operations.

Sample for the midterm exam

MSc Oil-mining Engineering (open-book) Test 17 /11/2017 NAME:

1. Characterize the natural nuclear disintegrations. Which radiation is mainly applied in geophysical exploration?
2. What do the heat flow lines and the isothermal lines present?
3. How can you classify the EM methods?
4. What do you mean by skin-depth?
5. What is the physical condition for the application of seismic reflection method?
6. What is the aim of the migration procedure? When is it applied to a seismic section?
7. What do you mean by acoustic impedance and reflection coefficient?
8. What do you know about AVO analysis?
9. What do you know about the relationship between longitudinal velocity and gas saturation?
10. What is the difference between polarity reversal and bright spot?

Sample for the final exam

Closed book exam, geophysical part 18/12/2017

NAME: NEPTUNE CODE:

1. What does a Bouguer gravity anomaly depend on?
2. What is the definition of heat flux and geothermal gradient?
3. What do you mean by static and dynamic correction?
4. What is the essence of bright spot?
5. What do you know about AVO analysis?

All answers can be found in .pdf files available for all students attending the course.