IN-FIELD SEISMIC TECHNIQUES AND INTERPRETATION

Petroleum Geoengineer MSc

2018/19 I. Semester

COURSE COMMUNICATION FOLDER

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

Course datasheet

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

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

Neptun code: MFGFT730012

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: Introduction into the basics, petrophysical aspects, applications and uses of reservoir geophysics. Students gain insight to the data acquisition, deata processing and interpretation geophysical data recorded over operational CH production fields.

Study goals:
Based on the lectures delivered during 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 visualization, amplitude studies, AVO, and elastic inversion. The petroleum production significance associated with each seismic data set evaluated is emphasized.

Short content of the course:
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 modelling, depth conversion. DHI analysis. Mapping of facies and characteristics, seismic inversion. Pressure and saturation monitoring, 4-D seismic method.
Education method: Electronic presentations by PC and projector. Software: OpendTect system installed on workstation.

Competencies to evolve:
T1, T2, T4, T5, T6, T9, T12, K2, K3, K6, K7, K9, A1

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):*

László Gombár Dr., engineer teacher

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

Tamás Fancsik, associate professor, CSc,
István Sebe (MOL Group),
Attila Somfai (MOL Group) ,
Péter Zahuczki (MOL Group),
Ernő Takács Dr., (MBFSZ)

Syllabus of the semester

Week	Lecture
Sept. 10.	Main types of HC reservoirs and their structural, petrophysical characterization
Sept. 17.	Overview of geophysical methods (seismic, gravity, EM and well logging) capable to provide information on reservoir parameters
Sept. 24.	Planning 2D and 3D seismic surveys for provision in-field information, data acquisition parameter selection, expected vertical and horizontal resolutions
Oct. 1.	Special data processing flows to gain reservoir information from recorded seismic data
Oct. 8.	Interpretation methods – matching well data and seismic data recorded in-field Matching VSP data and generation of synthetic seismograms from well-logs
Oct. 15.	Seismic inversion, generation of velocity fields, seis-log and velocity-log sections Generation and interpretation of different attribute sections (amplitude strength, instant frequency, instant phase). Generation and interpretation of different attribute sections (amplitude strength, instant frequency, instant phase), visualization methods
Oct. 22.	Holiday.
Oct. 29.	Searching for correlation between attributes and petrophysical parameters of the reservoirs (porosity, saturation, water content, HC content, potential permeability)
Nov. 5.	Three component seismic data recording techniques, generation and recording of P- and S-waves parallel; Special data processing steps of shear wave data; Joint interpretation of P and S seismic sections
Nov. 12.	4D seismic – repeated 3D seismic surveys during lifetime of the reservoir; Data acquisition and data processing of repeated 3D seismic surveys
Nov. 19.	Pressure and saturation monitoring with 4D during production phase
Nov. 26.	Application of direct HC detection methods (AVO) during production phase of a field
Dec. 3.	Application of passive seismic method for fracturing- and production monitoring
Dec. 10.	Main aspects of economic decision-making, the role of geotechnical information in decision-making

Week	Seminar
Sept. 10.	Interpretation of seismic sections, structural elements, correlation of seismic reflection horizons, reflection characterization 1. - paper sections
Sept. 17.	Interpretation of seismic sections, structural elements, correlation of seismic reflection horizons, reflection characterization 2.- paper sections
Sept. 24.	Introduction to IHS OpendTect interpretation sofware package
Oct. 1.	Structural interpretation of 2D seismic sections, correlation of different reflection horizons with Opendtect software
Oct. 8.	Structural interpretation of 3D seismic data cubes, correlation of different reflection horizons Opendtect software
Oct. 15.	Introduction to IHS Kingdom interpretation sofware package. Structural interpretation of 2D seismic sections, correlation of different reflection horizons with Kingdom software 1.
Oct. 22.	Holiday.
Oct. 29.	Structural interpretation of 2D seismic data cubes, correlation of different reflection horizons with Kingdom software 2.
Nov. 5.	Structural interpretation of 3D seismic data cubes, correlation of different reflection horizons with Kingdom software 1.
Nov. 12.	Structural interpretation of 3D seismic data cubes, correlation of different reflection horizons with Kingdom software 2.
Nov. 19.	Matching well data to seismic reflection sections, generation of impedance and reflection coefficient logs – generation of sysnthetic seismograms 1. - OpendTect
Nov. 26.	Matching well data to seismic reflection sections, generation of impedance and reflection coefficient logs – generation of sysnthetic seismograms 2. - OpendTect
Dec. 3.	Generation of AVO sections, data analyses and anomaly detection 1.- OpendTect
Dec. 10.	Generation of AVO sections, data analyses and anomaly detection 2.- OpendTect

Sample for exam questions

1. Main processing steps of a final seismic data processing project. What is the difference between cross-correlation and convolution of two time series?

2. The role of Static correction and Normal Move-out correction on CDP gather at multifold data process.

3. What are the SPS files are containing (R, S, X files) and what they are applied for?

4. When the so called „Crooked Bin" method is used during data processing?

5. What are the main steps of field QC data processing and what are the main differences comparing to final data processing?

6. How can be data processing carried out in VISTA? What are the main processing steps?

7. Describe the basics of AVO method!

8. Define the impedance types calculated from P-wave reflected surface seismic!

9. What is a wedge model?

10. How can we calculate synthetic seismogram?

11. What are the basic elements of the seismic record for an interpreter to study? What kind of reflection termination do you know?

12. What are the main steps of seismic interpretation? Summarize shortly the substance of each step!

21. What kind of datasets can we use in the integrated interpretation? What data should a well header file contain?

14. Give the items of the general flow of seismic interpretation!

15. What type of faults do you know? Describe them shortly in terms of movement?