SEISMIC COLLEGE

Earth Science Engineering MSc

2020/2021 / 1st Semester

COURSE COMMUNICATION FOLDER

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

Course datasheet

<table>
<tr><td>Course Title: Seismic college

Instructor:
Dr. Ernő Takács, PhD, Department Head at the faculty of Earth Science and Engineering, Chief Counsellor at the Mining and Geological Survey of Hungary</td><td>Code: MFGFT730029

Responsible department/institute:
Department of Geophysics / Institute of Geophysics and Geoinformatics
Type of course: Optional</td></tr>
<tr><td>Position in curriculum (which semester): 3</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: 4</td><td>Course: full time</td></tr>
<tr><td colspan="2">Course Description:
The aim of the course is to provide a comprehensive knowledge of seismic wave propagation and data processing. Students will get an overview about the acoustic and elastic rock properties and different wave types utilized in seismic exploration. They will study the aims and effects of various data processing steps in details and they will learn to build up and apply seismic data processing sequences. A practical exercise on real data will also be helpful to understand how to create migrated stacks for geological interpretation.

Competencies to evolve:
Knowledge: T1, T2, T3, T4, T5, T6, T7, T8, T9
Ability: K1, K2, K3, K12, K13
Attitude: A1, A2, A3, A4, A5, A7
Autonomy and responsibility: F1, F2, F3, F4, F5</td></tr>
<tr><td colspan="2">Short curriculum of the subject:
Year to year selected special topics are offered for the students in the fields of seismic data processing and interpretation (e.g. Common Reflection Surface stacking, Amplitude Versus Offset analysis). The subject is also useful for the students to obtain deep insight in the topic of their selected thesis work.</td></tr>
<tr><td colspan="2">Assessment and grading:
Signature requirement: working out a specific seismic task with written report.
Grading limits:
> 80%: excellent,
70-79%: good,
60-69%: medium,
50-59%: satisfactory,
< 50%: unsatisfactory.</td></tr>
<tr><td colspan="2">Compulsory literature:
<u>Books</u>:
• Yilmaz, Ö.: Seismic Data Analysis: Processing, Inversion, and Interpretation, 2001
• ProMAX Reference Manual (pdf)
<u>Papers</u>:
• Journal of Applied Geophysics, Vol. 42, Issues 3–4, Special issue on CRS stacking, 1999
<u>Periodicals for attention</u>: The Leading Edge, First Break, Geophysical Prospecting</td></tr>
</table>

Syllabus of the semester

Week	Lecture
1	Seismic wave generation and propagation and the most important petrophysical properties
2	Different types of the seismic waves and noises
3	Individual steps of the seismic data processing, data processing sequences
4	Procedure of the Common Reflection Surface stacking
5	Seismic data processing in ProMAX system
6	Seismic data processing in ProMAX system
7	Seismic data processing in ProMAX system
8	Seismic data processing in ProMAX system
9	Educational break
10	Seismic data processing in ProMAX system
11	Seismic data processing in ProMAX system
12	Seismic data processing in ProMAX system
13	Seismic data processing in ProMAX system
14	Summary and conclusions (discussions)

Week	Seminar
1	Generation of the seismic waves, velocity, density, compressibility, rigidity, and Poisson’s ratio. Acoustic and elastic impedances.
2	Reflected, refracted, and transmitted P- and S-waves. Linear and random noises and their attenuation.
3	Bandpass filtering, air and surface wave attenuation, AGC, deconvolution, refraction statics, automatic statics, velocity analysis, and NMO correction. CDP stacking, F-X decon, and migration.
4	CRS zero offset and dip search, CRS velocity precompute, CRS stacking
5	ProMAX processing on real seismic data (for CDP stacking)
6	ProMAX processing on real seismic data (for CDP stacking)
7	ProMAX processing on real seismic data (for CDP stacking)
8	ProMAX processing on real seismic data (for CDP stacking)
9	Educational break
10	ProMAX processing on real seismic data (for CRS stacking)
11	ProMAX processing on real seismic data (for CRS stacking)
12	ProMAX processing on real seismic data (for CRS stacking)
13	ProMAX processing on real seismic data (for CRS stacking)
14	Summary and conclusions (discussion)

Some sample questions for the midterm exam with answers

1. How do you classify the seismic waves by their propagation and particle motion? What are most important petrophysical properties guiding them?

   Reflected, refracted, and transmitted waves, P- and S-waves. Velocity, density, compressibility, rigidity, and Poisson's ratio.

2. How do you classify the seismic noises? Provide some examples of unwanted events from the viewpoint of reflection processing.

   Linear and random noises. Ground roll, airwave, first arrivals, wind, rain, and human activity on the survey area (e.g. agricultural work or traffic).

3. Describe a usual data processing sequence and explain the aims of the individual processing steps involved in it.

   Bandpass filtering, air and surface wave attenuation, AGC, deconvolution, refraction statics, automatic statics, velocity analysis, and NMO correction. CDP stacking, F-X decon, and migration. Their most important aims are to reduce the noises and enhance the signals.

4. List and explain the additional processing steps in case of CRS stacking. What are the advantages of a CRS stack against a CDP stack?

   CRS zero offset and dip search, CRS velocity precompute, CRS stacking. Higher quality imaging of the complex geological structures.