



# **ENGINEERING AND ENVIRONMENTAL GEOPHYSICS**

MS in Earth Science Engineering, Geophysical Engineering specialization

Second semester 2019/2020

**COURSE COMMUNICATION DOCUMENT**

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

## Course datasheet

<b>Course title:</b> Engineering and environmental geophysics <b>Responsible professors:</b> Norbert Péter Szabó Prof. Dr., Ph.D., dr. habil., university full professor	<b>Code:</b> MFGFT720013 <b>Responsible Institute/Department:</b> Institute of Geophysics and Geoinformatics / Department of Geophysics
<b>Semester:</b> second	<b>Pre-requisites:</b> MFGFT6002D, MFGFT6003D
<b>Number of Contact Hours per Week:</b> 2 lec. + 1 lab.	<b>Type of Assessment</b> (exam. / pr. mark / other): pr. mark
<b>Credits:</b> 4	<b>Type of Program:</b> full time <b>Program and Specializations:</b> MS in Earth Science Engineering, Geophysical Engineering
<b>Study goals:</b> Analysis of geotechnical, engineering geological, hydrogeological and environmental applications of near-surface geophysical methods, as well as a description of specific methods and their development trends. <b>Competencies to be developed:</b> 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	
<b>Course content:</b> Principles of surface geophysical methods. Gravity, magnetic, DC geoelectric, electromagnetic surveys. Ground penetrating radar (GPR), seismic refraction and surface wave's methods. Surface Nuclear Magnetic Resonance (sNMR) method. Description of the engineering geophysical penetration sounding methods and applications. Characterization of shallow unconsolidated sediments. Special borehole geophysical measurements: borehole radar, NMR. Investigating the relationship between the petrophysical, lithological and geotechnical characteristics and measured physical parameters. Single and joint interpretation of geophysical data (single and joint inversion, tomography) based on different physical bases for 1D, 1.5D, 2D and 3D models. Application of shallow geophysical methods for environmental and engineering tasks and water prospecting. Special tasks in void detection, hydrogeophysics, archaeological geophysics. Forensic and military applications. Presentation of geophysical instruments in laboratory. Instruments applied in the field practice.	
<b>Type of assessment:</b> Attendance at lectures is regulated by the university code of education and examination. Two writing tests (the weight of each grade item is 50 %). One assignment during the semester is the requirement of signature. <b>Grading scale:</b> >86 %: excellent, 71-85 %: good, 61-70 %: medium, 46-60 %: satisfactory, <45 %: unsatisfactory.	

**Compulsory and recommended literature resources:**

- Sharma P. V., 1997. Environmental and engineering geophysics. Cambridge University Press.
- Everett M. E. , 2013. Near-surface applied geophysics. Cambridge University Press.
- Milsom J., 2003. Field Geophysics. 3<sup>rd</sup> edition. Wiley.
- Kirsch R. (editor), 2009. Groundwater Geophysics – A Tool for Hydrogeology. Springer.
- Butler, D.K. (szerk.), 2005: Near-Surface Geophysics (in series: Investigations in Geophysics, No. 13.) SEG, Tulsa.
- Szabó N. P., 2014. Environmental and engineering geophysics. Electronic textbook. <http://www.uni-miskolc.hu/~geofiz/education.html>

**Course schedule**

<b>Date</b>	<b>Lecture</b>
11 February 2020	Classification of near-surface applied geophysical methods. Basic principles of microgravity surveying methods, correction of measurements. Calculation of derivatives. Engineering and environmental applications.
18 February 2020	Basic principles of magnetic methods, correction of measurements. Magnetic gradiometry. Pole reduction and analytic continuation techniques. Engineering and environmental applications.
25 February 2020	DC geoelectric measurement methods. Inversion and interpretation of pseudo-resistivity profiles, maps. Engineering, environmental, archaeological and geophysical applications.
3 March 2020	Time- (TDIP) and frequency domain (FDIP) induced polarization measurements. Geological causes of polarization types. The time constant spectrum. The delineation of contaminated zones.
10 March 2020	Frequency-domain EM surveying methods. The induction method. Shallow applications of frequency sounding.
17 March 2020	Time-domain (transient) EM surveying methods and their shallow applications. Detection of highly conductive structures.
24 March 2020	The physical background of surface nuclear magnetic resonance sounding. Determination of the depth distribution of the water content.
31 March 2020	Writing the first test.
7 April 2020	Near-surface application of the seismic method. Refraction method, its theory and possibilities of use.
14 April 2020	Surface-wave seismic method, dispersion analysis.
21 April 2020	Engineering and environmental applications of the seismic method.

28 April 2020	Theory of engineering geophysical sounding methods. Investigation of the relationship between the petrophysical (water, air saturation, clay content, matrix fraction) and geotechnical (dry density) characteristics and measured physical parameters. Opportunities for inversion evaluation.
5 May 2020	Writing the second test.
12 May 2020	Repeating the writing tests. Submission of individual assignment.

<b>Date</b>	<b>Seminar</b>
13 February 2020	Inversion and interpretation of microgravity data. Application examples.
20 February 2020	Inversion and interpretation of magnetic data. Application examples.
27 February 2020	Inversion and interpretation of DC geoelectric data. Application examples.
5 March 2020	Inversion and interpretation of TDIP data. Application examples.
12 March 2020	Interpretation of FDEM data. Application examples.
19 March 2020	Interpretation of TDEM data. Application examples.
26 March 2020	Interpretation of sNMR data. Application examples.
2 April 2020	Presentation of the measuring instruments (laboratory practice).
9 April 2020	Processing and interpretation of refraction seismic data. Application examples.
16 April 2020	Processing and interpretation of surface seismic data. Application examples.
23 April 2020	No teaching.

30 April 2020	Presentation of the measuring instruments (field practice). Submission of individual assignment.
7 May 2020	No teaching.
14 May 2020	Repeating the writing tests.

### Sample of writing test

1. What type of data reduction techniques are applied to microgravity data?
2. What type of geophysical methods can be used to sinkhole detection?
3. What type of well logs are used in the evaluation of aquifers? What petrophysical parameters are determined?
4. Determination of low-velocity layer parameters ( $V_0$ ,  $V_1$ ,  $h_0$ ) with refraction survey. Steps of plus-minus processing method.
5. Please detail P and S wave down-hole and cross-hole measurements. Give the calculation formulas for basic elastic parameters.

### Solution

The answers can be found in the course material “Environmental and engineering geophysics” (and the recommended literature) uploaded to the site of the Department of Geophysics:  
<http://www.uni-miskolc.hu/~geofiz/education.html>