ENVIRONMENTAL AND ENGINEERING GEOPHYSICS

Environmental Engineering MSc

Second semester 2017/2018

COURSE COMMUNICATION DOCUMENT

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

Course datasheet

Course Title: Environmental and Engineering Geophysics	Credits: 5
Type of course: compulsory	Program: Environmental Engineering MSc Neptun code: MFGFT720018

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

Type of Assessment (exam. / pr. mark. / other): **exam (oral)**

Attendance at lectures is regulated by the university code of education and examination. Writing two tests at least satisfactory level, respectively, and two individual assignments (one powerpoint presentation and one report on field practice) during the semester are the requirement of signature.

Grading scale: > 86 %: excellent, 71-85 %: good, 61-70 %: medium, 46-60 %: satisfactory, <45 %: unsatisfactory.

Position in Curriculum (which semester): **second**

Pre-requisites *(if any)*: -

Course Description:

Study goals

Understanding the basics of shallow geophysical surveying methods, through which the geometric and geophysical parameters of the subsurface environment can be determined, primarily for environmental research purposes. Overview of special geophysical methods and their developmental trends.

Course content

Principles of near-surface geophysical methods. Microgravity and magnetic surveys. DC geoelectric, multi-electrode, induced polarization, electromagnetic techniques. Ground penetrating radar, seismic refraction and surface NMR methods. Principles of engineering geophysical sounding (direct push) methods. The application of direct push methods. Investigation of the geophysical parameters and the lithological/geotechnical properties of soils/rocks. Interpretation of geophysical data by deterministic methods. Statistical and inversion-based interpretation methods. 1D, 2D and 3D modeling of shallow geological structures. Geophysical inversion methods, numerical aspects. Engineering and environmental applications: sinkhole detection, investigation of voids and cavities. Seawater intrusion, contamination assessment, archeo-geophysics, forensic studies, unexploded ordnance detection. Geophysical and geotechnical characterization of soils, road constructions etc.

Education method

Lectures with projected PowerPoint presentation, laboratory and field measurements.

Competencies to evolve

T1 - The environmental engineer knows, and apply the scientific and technical theory, and practice. T2 - The environmental engineer has the knowledge of environmental measurement technology and theory. Active professional English language skills.

The 3-5 most important compulsory, or recommended **literature** (textbook, book) **resources**:
• Sharma P. V., 1997. Environmental and engineering geophysics. Cambridge University Press. • Everett M. E., 2013. Near-surface applied geophysics. Cambridge University Press. • Kirsch R. (editor), 2009. Groundwater Geophysics – A Tool for Hydrogeology. Springer. • Butler, D. K. (ed.), 2005: Near-Surface Geophysics (in series: Investigations in Geophysics, No. 13.) SEG, Tulsa. • Scientific papers selected from geophysical journals, e.g., First Break, Near Surface Geophysics, Geophysics, Journal of Applied Geophysics etc. • Szabó N. P., 2014. Environmental and engineering geophysics. Electronic textbook. http://www.uni-miskolc.hu/~geofiz/education.html
Responsible Instructor (*name, position, scientific degree):* **Norbert Péter Szabó Dr., associate professor, PhD, dr. habil.**
Other Faculty Member(s) Involved in Teaching, if any (*name, position, scientific degree*):

Course schedule

Date	Lecture
13 February	Classification of near-surface applied geophysical methods. Basic principles of microgravity surveying methods, correction of measurements. Calculation of derivatives. Environmental and engineering applications.
20 February	Basic principles of magnetic methods, correction of measurements. Magnetic gradiometry. Environmental and engineering applications.
27 February	DC geoelectric measurement methods. Interpretation of resistivity profiles, maps. Environmental, archaeological and geophysical applications.
6 March	Time- and frequency domain induced polarization measurements. Geological causes of polarization types. The time constant spectrum. The delineation of contaminated zones.
13 March	Frequency-domain EM surveying methods. The induction method. Shallow applications of frequency sounding. Time-domain (transient) EM surveying methods and their shallow applications.
Holiday	-
27 March	Near-surface application of the seismic method. Refraction method, its theory and possibilities of use. Environmental and engineering applications of the seismic method.
3 April	Writing the first test.

10 April	The physical background of surface nuclear magnetic resonance soundings. Determination of the depth distribution of the water content. Well-logging in shallow wells. Well logging methods used for the determination of lithology, porosity and water saturation. Groundwater well logging applications. Borehole radar measurements.
17 April	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.
24 April	Field trip.
Holiday	-
8 May	Writing the second test. Simulated conference.
15 May	Repeating the writing tests.

Date	**Seminar**
13 February	Mathematical and physical basics of microgravity method, correction of measurements. Inversion of gravity data.
20 February	Mathematical and physical basics of magnetic method, correction of measurements. Inversion of magnetic data.
27 February	Mathematical and physical basics of DC geoelectric methods. Inversion of resistivity data.
6 March	Mathematical and physical basics of induced polarization methods. The Tau-transform.
13 March	Mathematical and physical basics of FDEM and TDEM methods.
Holiday	-
27 March	Mathematical and physical background of seismic methods.
3 April	Writing the first test. Presentation of the measuring instruments (laboratory practice).

10 April	Giving the assignment (one powerpoint presentation) to the students. Selection of topics.
17 April	The mathematics of well logging and engineering geophysical sounding methods. The forward problem. The estimation of petrophysical (soil) parameters using inversion techniques.
24 April	Field measurements.
Holiday	-
8 May	Writing the second test. Simulated conference. Students deliver the powerpoint presentations on the assigned topics. Evaluation of presentations. Repetation and improvement of writing tests.
15 May	Repeating the writing tests.

Sample of exam questions

1. Principles of the gravity method and the main corrections made to microgravity data.
2. Application of EM methods in near-surface investigations.
3. Principles of engineering geophysical sounding methods and their environmental applications.
4. The workflow of geophysical inversion. Petrophysical modeling of shallow geological structures. Inversion of well logs.
5. Geophysical and geotechnical characterization of soils. Inversion of direct push data.
6. Engineering and environmental applications: sinkhole detection, investigation of voids and cavities, seawater intrusion, contamination assessment, archeo-geophysical issues, unexploded ordnance detection.