Geotechnics I

Code: MK3GTH1S6SX17-EN

ECTS Credit Points: 6

Evaluation: exam grade

Year, Semester: 2rd year, 4th semester

Its prerequisite(s): Civil Engineering Orientation, Strength of Materials

Further courses are built on it: Yes

Number of teaching hours/week (lecture + practice): 4+2

Topics:

The main aim of the course to give a global perspective and understanding of geological and geotechnical processes specifically tailored to students majoring in engineering. Topics includes: plate tectonic movements; the interactions between the solid earth, hydrosphere and atmosphere; the formation and identification of important mineral and rock materials that make up the surface of the Earth; why volcanoes and earthquakes occur; what determines their locations; what are the major milestones in the evolution of the Earth and what is the local geologic history of Hungary. Soil mechanical explorations, methods, and tools. Soil physics, particle size distribution, phase relations. Natural water content, and consistency limits (shrinkage, plastic, saturation, liquid). Indexes (plasticity, consistency). Compaction and Proctor test. Classification of soil. Strength, stresses in the soil at failing. Water in the soil. Effective and neutral stresses. Overburden pressure. Flow of water through soil due gravity (Darcy's law, coefficient of permeability, flow nets). Shear strength of soil (Mohr-Coulomb failure criterion).

The course is supposed to provide students with necessary knowledge to be able to participate in engineering geological and geotechnical field and laboratory research upon obtaining their bachelor's degree.

Literature:

Compulsory:

- Kezdi, A.: Soil Mechanics
- Bell, F. G.: Engineering geology. 2nd edition, Elsevier, 2007. ISBN-13: 978-0-7506-8077-6; ISBN-10: 0-7506-8077-6

Recommended:

- Bell, F. G.: Fundamentals of engineering geology. Butterwords, London, 1983.
- Blyth, F. G. H.; Freitas, M. H.: A geology for engineers. 7th edition, Elsevier, 1984. ISBN 0 7131 2882 8
- Xiao, Ming: Geotechnical engineering design. Blackwell Publishers (Wiley), 2015. ISBN-13: 9780470632239; ISBN-10: 0470632232
- Bell, F. G.: Geological hazards. Taylor&Francis. ISBN 0-419-16970-9
- Sivakugan, Nagaratnam; Shukla, Sanjay Kumar; Das, Braja M.: Rock mechanic. And introduction. Taylor&Francis. 2015. ISBN-13: 9780415809238; ISBN-10: 0415809231
- Thomson, G.R. and Turk, J.: Modern Physical Geology, Sounders College Publishing, a division of Holt, Rinehart and Winston Inc., Orlando FL, 1991
- Atkinson, J.: The Mechanics of Soils and Foundations. Taylor and Francis, London, 2007.
- Powrie, W.: Soil Mechanics Concepts and Applications (Third edition) CPR Press, Boca Raton, London, New York, 2014
- Craig, R. F.: Craig's Soil Mechanics. Spon Press, Taylor and Francis Group, London, 2004.
- Kempfert, H. G., Gebreselassie, B.: Excavations and Foundations in Soft Soils. Springer, 2006
- Lambe, J., Whitman, G.: Soil mechanics, SI-Version. John Wiley and Sohn, New York, 1979.

Schedule

1st week Registration week

2nd week:

Lecture: Earth sciences and geotechnics. Origin of the Solar System and the Earth. The structure of the Earth, plate tectonics, magmatism and volcanism, rock cycle. Concepts of mineralogy and geology. Ingeous rocks (origin, types and features).

Practice: Basics of mineralogy. Identifications of minerals. Characterization of most important rock forming minerals. Identification and characterization of igneous rocks.

3rd week:

Lecture: Origin of sedimentary rocks. Weathering. Clastic, chemical-biogenic, chemical and biogenic sedimentary rocks. Classification, characterisation. Metamorphic rocks.

Practice: Identification of and characterization of sedimentary and metamorphic rocks. Building stones, rocks as construction raw materials.

4th week:

Lecture: Basics of structural geology, plastic and fractured deformation in the Earth crust. Historical geology, stratigraphy, Earth history. Regional geology of the Earth. Endogene and exogene processes (volcanism, earthquakes, mass movements, ground subsidence, erosion, abrasion etc.)

Practice: Methods and sources of geological data collection. Geological sections and maps and their editing.

5th week:

Lecture: Site investigation methods (indirect and direct), augering, drilling and sampling of soils and rocks. Basic mineralogical laboratory tests. Groundwater and its types, aquitards, aquicludes and aquifers. Groundwater movement. Wells.

Practice: Presentation of augering and soil sampling methods. Geological and hydrogeological databases and their usage. Engineering geological maps.

6th week:

Lecture: Basic rock mechanics. Rock strength and discontinuities. Rock mass classification methods and their application. Engineering geology and mapping.

Practice: Case studies

7th week:

Lecture: Soil particle sizes and distribution.

Midterm test.

Practice: Presentation of sieving and hydrometring. Editing of distribution curve.

8th week: 1st drawing week

9th week:

Lecture: Hydrometer analyses. Parameters of the particle size distribution curve. Phase, weight-volume relationships of soils.

Practice: Calculating of phase, weight and volume ratios of soils. Density and bulk density of soils. Proctor test. Editing of Proctor curve.

10th week:

Lecture: Index tests and classification of soils. Shrinkage, plastic,saturation and liquid limits. Shrinking and swelling. Linear shrinkage and swelling pressure. Soil compaction. Proctor test.

Practice: Testing of Atterberg limits. Calculation of limits and relating indexes.

11th week:

Lecture: Stress in soils (total, effective, and neutral). Overburden pressure. Mohr/Coulomb failure criteria.

Practice: Classification and qualification of soils (usage, compaction etc.). Practical calculations of compaction, phase, weight and volume ratios.

12th week:

Lecture: Soil mechanics parameters describing the strength of the soil (internal friction and cohesion). Laboratory tests describing these parameters.

Practice: Presentation of various (unaxial, triaxial, direct shear etc.) soil strength tests, relating calculations.

13th week:

14th week:

Lecture: Prestress of the soil. Overconsolidation ratio (OCR). Critical state theory. Cam Clay model and related soil mechanics parameters. **Practice:** Vertical stress calculations (included total stress, pore water pressure and effective stress).	**Lecture:** Deformation of soil. Oedometer test. 1D compressional moduli. End of semester test. **Practice:** Consultation in connection with drawing project.

15th week: 2nd drawing week / 2nd test

Requirements

A, for a signature:

Attendance: Participation at lectures is critical to successful completion of this course. For the laboratory/problem solving classes the participation is compulsory. More than 3 unexcused absences result incompletion of the course. There are no make up labs with another group. Tests and oral exam questions will be covered in lectures. Making lecture notes is critical to complete the course.

B, for a grade:

Completion of the course: Submitting the laboratory reports and the homework assignments. Participating at least 70% at laboratory/problem solving. D or higher grades for both tests. There is one make up test for each. Grading of tests:

Score	Grade
0-60	(F) fail (1)
61-70	(D) pass (2)
71-80	(C) satisfactory (3)
81-90	(B) good (4)
91-100	(A) excellent (5)

Grading of the course:

Mid term test 20%

End of semester test 20%

Final (verbal exam) 60%

Oral exam is taken at the end of the semester in the exam period. Students have to sign up for the scheduled exam in the Neptun System minimum two days in advance.