**Geotechnics II**

**Code:** MK3GTH2S6SX17EN

**ECTS Credit Points:** 6

**Evaluation:** exam grade

**Year, Semester:** 3rd year, 5th semester

**Its prerequisite(s):** Geotechnics I.

**Further courses are built on it:** Yes

**Number of teaching hours/week**:

Lecture: 4

Practice: 2

**Topics:**

Standards and codes of practice in geotechnical engineering. Soil compressibility, consolidation, and settlements. Engineering soil properties and their measurement. Understanding and preparing soil mechanics reports and recommendation.

Stresses in the infinite half-space at rest, plastic equilibrium in soils. Earth pressure determination, active and passive earth pressure situations. Slope stability analysis resistance, non-cohesive and cohesive land mass analysis, vertical stability of earth walls. Supporting land of permanent and temporary structures (retaining walls, gabions, reinforced soil structures, traditional bracing Siemens bracing, sheet piling, bracing modern systems). Earthworks drainage (surface and subsurface drainage, work trenches, drainage trenches and work spaces, advanced dewatering processes). Earthworks design (design works, earth works in calculating the quantity, distribution of land masses). Construction of earthworks and earthmoving. Earth-moving machinery.

Scope of earth works. Plastic limit states, Rankine earth pressures. Earth pressure and passive resistance of real” walls. Soil static design of retaining structures. Stability of earth works.

**Literature:**

*Compulsory:*

1. Kezdi, A.: Soil Mechanics

*Recommended:*

1. Bell, F. G.: Engineering Geology and Construction. Taylor and Francis, London, 2004.

2. Hausmann, M.: Engineering principles of ground modification. Mc Graw – Hill

Publishing Company, New York, 1986.

3. Kempfert, H. G., Gebreselassie, B.: Excavations and Foundations in Soft Soils. Springer,2006

4. Koerner, R. M.: Designing with Geosynthetics. Prentice Hall, Englewood Cliffs, 2005.

5. Atkinson, J.: The Mechanics of Soils and Foundations (Second edition), Taylor and Francis, London and New York, 2007

6. Powrie, W.: Soil Mechanics Concepts and Applications (Third edition) CPR Press, Boca Raton, London, New York, 2014 1. Look, B.: Handbook of geotechnical investigation and design tables. Taylor and Francis,London, 2007.

7. Lunne, T., Robertson, P. K., Powell, J. J. M.: Cone penetration testing in geotechnical practice. Spon / Routledge, London, New York, 2002.

8. Terzaghi, K.: Theoretical soil mechanics. John Wiley and Sons, New York, 1943.

9. Terzaghi, K., Peck, R.: Soil mechanics in engineering practice. John Wiley and Sons,New York, 1943.

10. Whitlow, R.: Basic soil mechanics. Longman Scientific and Technical, 1990.**Schedule**

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| **1st week Registration week** | |
| **2nd week:**  **Lecture:** Filter criteria. Self-filtering. Ground freezing.  Capillarity. Seepage pressures and hydraulic failing.  **Practice:** Presentation of in-situ and laboratory permeability testing methods (constant and falling head laboratory apparatus, infiltrometer methods, pumping test in wells). Calculation of hydraulic conductivity used by empirical formulas. Calculation of groundwater flow. Editing of flow net. Assessment of capillary rise. | **3rd week:**  **Lecture:** Liquefaction.  Ground water. Yearly cycle of the water table at continental climate. Predicting the characteristic value of ground water level.  **Practice:** Presentation of oedometer test procedure. Editing of compression curve and consolidation curve. Calculation of the 1D compression moduli.Determining of preconsolidation pressure, compression and recompression index. |
| **4th week:**  **Lecture:** Soil explorations. Site investigations, boring and sampling. Soil mechanics report. Contents and drawing supplements (Plan view, Borehole log, cross section.).  **Practice:** Field presentation of drilling, hand-augering, soil sampling, groundwater sampling, dynamic penetrometer testing and vane shear test. | **5th week:**  **Lecture:** Determination of cross-section area and calculating the volume of soil. Diagram and the distribution of masses. Parameters, factors for design of slopes. Types of instability of slopes. Stress change on slopes.  **Practice:** Evaluation of laboratory testing results. Assessment of soil physical parameters by empirical formula. Qualification of soils (using for earthworks, compaction, frostbite, etc.). Evaluation of field test results (dynamic penetrometer, cone penetration test, vane shear test). |
| **6th week:**  **Lecture:** Influence of water on the stability of slopes. Stability of infinite slopes. Influence of seepage on the stability. Stability of vertical cut. Design of simple excavations.  **Practice:** Calculation of characteristic values of soil mechanical parameters. Writing of geotechnical site investigation report. Editing of soil mechanical log, and cross section. | **7th week:**  **Lecture:** The compaction process. Relevant laboratory and field testing for soil properties and compaction. Compaction equipment; application for various materials. Quality control and testing requirements  Midterm test.  **Practice:** Consultation about drawing project. |
| **8th week: 1st drawing week** |  |
| **9th week:**  **Lecture:** Lateral earth pressure at rest. Rankine’s lateral earth pressures (active, passive). Earth pressure with sloping backfill. Graphic solution for Coulomb’s active earth pressure (Culmann’s solution). Active and passive force with earthquakes force. Calculating the earth pressures for drained and undrained loading.  **Practice:** Concepts and general features of earthworks. Long and cross sections, volume calculations. Soil suitability. | **10th week:**  **Lecture:** Type of retaining structures (Gravity walls, cantilever walls, anchored or propped walls). Pressure on retaining wall due to surcharge. Failure of retaining walls. Dewatering and filtering systems of retaining walls.  **Practice:** Calculation of lateral earth pressure (at rest, active and passive state) in non-cohesive and cohesive soils. |
| **11th week:**  **Lecture:** Mechanism based kinematic and equilibrium solutions for gravity retaining walls. Soil strength and factors for design of retaining walls. Stress changes in soil near retaining walls. Influence of water on retaining walls. Reinforced soil walls. Compaction stresses.  **Practice:**  Slope stability investigation in homogeneous soil using friction circle method. | **12th week:**  **Lecture:** Dewatering during construction. sump and ditches; deep-well, well-points (conventional and vacuum), horizontal drainage. Well theory. Confined aquifer (full, partial penetration well). Group wells. Filter design (Terzaghi’s criteria)  **Practice:** Stability analyses of gravity retaining walls. |
| **13th week:**  **Lecture:** Cut offs (Cement and chemical grout curtains; Slurry walls; Concrete walls; Steel sheet piling; Freezing) Pumping test. Discharge, environmental problems. Additional settlement from the reduction of water table.  **Practice:** Stability analyses of sheet piles. | **14th week:**  **Lecture:** Summary. Preparation for the test. End of Semester test.  **Practice:** Consultation with the assigned design projects. |
| **15th week: 2nd drawing week** | |

**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 mandatory. More than 3 unexcused absences result in no completion 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 Home Work 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 15%

End of semester 15%

Slope stability HWA10%

Retaining wall HWA 10%.

Final (verbal exam) 50%

An 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.