Name of subject	GEOTECHNICAL ENGINEERING (8 ECTS)
Subject/module code	**GM13408**
Science taught semester (s).	3rd and 4th semesters
Module leader	Professor Inomjon G‘aniyev, Candidate of Technical Sciences, Head of the Department of Road Engineering
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours – 240 hours** **Contact hours – 96 hours** Lecture training hours – 48 hours Practical training hours – 48 hours **Independent study – 144 hours**
Course work	No
ECTS	8
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** to explain how soil composition, groundwater conditions, stress, deformation and strength affect the performance of the ground beneath a road, its earthworks and adjacent structures. They learn to perform preliminary geotechnical calculations and justify their assumptions. **The objectives of teaching the subject** are to study the geological setting and the origins of soils. Describe and classify soils and interpret site investigation and test records. Calculate seepage, effective stress, compaction, compressibility, consolidation and shear resistance. Assess the behaviour of road embankments, slopes, retaining walls and foundations. Select ground improvement measures and monitoring methods for difficult ground conditions. **Learning outcomes:** 1. Explain how minerals, rocks, soil formation and geological processes influence ground conditions beneath roads. 2. Build a geotechnical ground model from geological sections, investigation records and test data. Identify the source and uncertainty of its parameters. 3. Calculate soil phase relationships, particle-size distribution and plasticity indices, and justify the resulting classification. 4. Calculate seepage, pore-water pressure, total stress and effective stress for the groundwater conditions given. 5. Determine optimum water content and maximum dry density from a compaction curve, and use field density measurements to determine the degree of compaction. 6. Interpret oedometer data and calculate one-dimensional settlement and consolidation time using a simplified model. 7. Distinguish drained and undrained conditions. Select the corresponding strength parameters and use them in a shear calculation. 8. Check lateral earth pressure, retaining wall stability, shallow foundation bearing capacity and settlement separately. 9. Assess the effects of water, weak ground and seismic loading on a slope or road embankment. Compare ground improvement or drainage options. 10. Prepare a geotechnical report containing a cross-section, material parameters, checked calculations and monitoring recommendations. Defend the individual contribution to the report.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions).**

	Topics: 1. Geotechnical problems in road engineering. 2. Soil origins and geological setting. 3. The three-phase soil model. 4. Particle size, plasticity and soil classification. 5. Geotechnical investigation and data quality. 6. Groundwater and pore-water pressure. 7. Seepage and drainage. 8. Total and effective stress. 9. Stress increases within a soil mass. 10. Mechanical compaction and quality control. 11. Compressibility and oedometer results. 12. Consolidation and time-dependent settlement. 13. Soil shear strength. 14. Lateral earth pressure. 15. Retaining walls and reinforced soil. 16. Bearing capacity of shallow foundations. 17. Total and differential foundation settlement. 18. Introduction to piled foundations. 19. Stability of slopes and cuttings. 20. Road embankments on soft ground. 21. Difficult ground and geological hazards. 22. Ground improvement and geosynthetics. 23. Introduction to earthquake geotechnics. 24. Geotechnical monitoring and reporting. **II. Instructions and recommendations for organizing laboratory exercises** Laboratory work is not included in the curriculum **III. Practical training instructions and recommendations** The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform. Methodological guidelines serve as the primary instructional document for instructors in preparing and conducting practical sessions. The purpose of the practical session is to facilitate the comprehension of theoretical material, the acquisition of practical skills, the ability to consciously apply knowledge in academic and professional activities, and the development of critical thinking and confidence in forming personal viewpoints. *Recommended Practical Topics:* 1. Construct a geotechnical section from a geological map and borehole logs. Show the ground strata, rock types, water level and initially identified hazards. 2. Calculate three-phase soil relationships. Submit a table of water content, density, porosity and degree of saturation with the units checked. 3. Analyse particle-size distribution. Submit the grading curve, characteristic particle diameters and a justified soil description. 4. Classify soil by its plastic properties. Prepare a parameter sheet recording the plasticity indices, soil type and limits on using the values in calculations. 5. Interpret supplied SPT and CPT records and soil sample descriptions. Tabulate the strata and conditions for applying correlations, and list missing information.

	6. Draw a groundwater profile and pore-water pressure diagram. Show pressure distributions for alternative water levels and explain the piezometric observations. 7. Use Darcy's law to calculate seepage discharge and determine the critical hydraulic gradient. Submit a flow diagram, calculations and a preliminary assessment of hydraulic uplift. 8. Determine total and effective stresses in layered soil. Plot stress against depth for dry ground and ground affected by groundwater. 9. Calculate the stress increase beneath a road embankment or a foundation. State the model, tabulate results by depth and identify the zone of influence. 10. Analyse a compaction curve and field density data. Report optimum water content and maximum dry density, and assess compliance with the specified acceptance criterion. 11. Derive compressibility parameters from oedometer data. Present the analysis plot, selected stress range and parameter table. 12. Calculate consolidation settlement and the time required. State the model and compare the results for single and double drainage. 13. Interpret shear strength test results. Record the choice of effective cohesion c′ and effective friction angle φ′, or undrained shear strength, for the drainage conditions given. 14. Calculate lateral earth pressure. Draw pressure diagrams showing wall movement conditions, surcharge effects and water pressure separately. 15. Check a retaining wall for sliding, overturning, base pressure and bearing capacity. Submit the calculations and a drainage layout. 16. Calculate shallow foundation bearing capacity. Tabulate preliminary dimensions and justify the soil, groundwater and loading conditions assumed. 17. Estimate foundation settlement layer by layer. Separate the settlement components, assess differential settlement and compare the options. 18. Prepare a preliminary assessment of a single pile and a pile group. Tabulate base and shaft resistance, group effects and additional checks required. 19. Compare a slope under dry and water-affected conditions. Submit a simplified stability analysis and explain its sensitivity to water conditions and strength parameters. 20. Estimate settlement and assess staged loading of an embankment on soft ground. Provide a loading sequence, a drainage option and a list of quantities to monitor. 21. Evaluate the collapse of soil on wetting. Calculate collapse settlement from the supplied test data and propose measures to limit water ingress. 22. Compare ground improvement options. Tabulate technical requirements and resources for compaction, replacement, drainage and geosynthetic solutions. 23. Screen for seismic and liquefaction hazards. Prepare a record of data adequacy, model assumptions and areas requiring detailed investigation. 24. Defend a settlement and pore-water pressure monitoring plan. Submit the monitoring layout, warning thresholds and consolidated geotechnical report. **IV. Independent learning and independent work** Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional

	activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form. Recommended topics for independent work: 1. Describe the geological setting of a selected road section. Prepare a geotechnical cross-section and a record of the input data and their sources. 2. As a small group, compile a dataset covering soil classification, particle-size distribution, plasticity and phase relationships. Document peer checks of the calculations. 3. Analyse two groundwater-level scenarios and their effects on seepage and effective stress. 4. Calculate the stress increase and compaction parameters for road earthworks. Identify the source of each parameter. 5. As a small group, carry out compressibility and consolidation calculations. Compare the effects of alternative drainage paths and time periods. 6. Assemble the semester 3 geotechnical portfolio. Individually defend the section, soil description and calculations for groundwater, stress and settlement. 7. Develop strength and lateral earth pressure cases for the drainage conditions given. Account for water pressure separately. 8. Make a preliminary comparison of shallow and piled foundations in terms of ground conditions, load, predicted settlement and construction conditions. 9. As a small group, justify options for improving the stability of a slope or a road embankment on soft ground. 10. Map difficult ground and seismic factors. Identify additional investigations needed to characterise geological hazards. 11. As a small group, develop a ground improvement and monitoring plan. Compare technical performance, resources, data quality and warning measures. 12. Prepare and individually defend a consolidated geotechnical report. Critically apply the settlement and monitoring approach of the research paper [6] to the study case.
Exam form	Written
Teaching/learning and examination requirements	Complete mastery of theoretical and methodological concepts and practical knowledge of the discipline, the ability to correctly reflect the results of analysis, independently reason about the processes being studied and carry out tasks in the current, intermediate forms of control and independent work, pass written work on the final control. When drawing up final exam questions, deviations from the content of the discipline program are not allowed. The bank of final exam questions for each discipline is discussed at the meeting and approved by the head of the department. No later than 1 week before the start of the final control, tickets signed by the head of the department, enclosed in an envelope, are sealed by the Dean's office and opened 5 minutes before the start of the exam in the presence of students. Final exam duration is 80 minutes. Answers to final exam questions are recorded in copybooks with the seal of the Dean's office. After completion of the final work, the work is immediately encrypted by a representative of the Dean's office, and the copybooks are handed over to the commission for verification. From the moment of completion of the final exam, a period of 72 hours is allotted for checking and posting the results on the electronic platform. The teacher who taught the students in this discipline is not involved in the process of conducting the exam and checking the students' answers.

	Student(s) who are dissatisfied with the final exam results may submit a written or oral appeal within 24 hours of the publication of the final exam results. Complaints submitted after 24 hours from the publication of the final exam results will not be accepted.
Scope of assessment criteria and procedure	CURRENT CONTROL Purpose: Determining and assessing the student's level of knowledge, practical skills, and competencies on course topics. Instructions: The student's activity in daily classes is assessed through the student's mastery of course topics, as well as constructively interpreting and analyzing the educational material, developing module specific skills, acquiring practical skills (in terms of quality and the specified number) and competencies, solving problem situations aimed at applying professional practical skills, working in a team, preparing presentations, etc. Current control form: Activity in lessons; Preparing educational materials; Working with sources within the subject; Using educational technologies; Working in a team Preparing presentations; Working with projects. MIDTERM CONTROL Purpose: Assessing the student's knowledge and practical skills and level of mastery of lecture material after completing the relevant section of the course. Form and procedure of intermediate control: Midterm examination is held during the semester during the training sessions after the completion of the relevant module of the curriculum of the subject. Midterm examination is held once in written form within the framework of this subject. Midterm examination questions cover all topics of the subject. INDEPENDENT LEARNING Purpose: Independent learning is aimed at fully covering the content of this course, expanding the theoretical knowledge acquired, and establishing independent learning activities for students. Form and procedure of independent education: independent work assignments are completed in the form of an educational project, presentation, case study, problem solving, information search, digest, colloquium, essay, article, abstract, etc. Completed assignments for independent study are placed in the electronic system and checked based on the anti-plagiarism program and evaluated by the subject teacher. In this case, the uniqueness of the completed assignment should not be less than 60%, otherwise the assignment will not be accepted for assessment. The number of independent work assignments, depending on the nature of the subject, should not be less than 3 for one subject (module). Independent work assignments account for 60% of the points allocated for current and intermediate control. FINAL CONTROL Purpose: The final examination is held at the end of the semester to determine the level of mastery of the student's theoretical knowledge and practical skills in the relevant subject. The final examination is held at a specified time according to the examination schedule created by the Registrar's Office on the electronic platform. Requirements: The student must have passed the current control, intermediate control and independent learning assignments by the deadline for the final control type in the relevant subject. A student who has not passed the current control, intermediate control and independent learning assignments, as well as who has received a score in the range of “0-29,9” for these assignments and control types, is not included in the final control type. Also, a student who has missed 25 percent or more of the classroom hours

allocated to a subject without a reason is excluded from this subject and is not included in the final control type and is considered not to have mastered the relevant credits in this subject. A student who has not passed or was not included in the final control type and has received a score in the range of "0-29.9" for this type of control is considered to be an academic debtor.

Final control form: The final examination in this subject will be conducted in written form. If the final examination is conducted in written form, the requirements for assessment must also be reflected.

Criteria for assessing student knowledge

5 grade	100 points		Assessment criteria
5	90-10	Excellent	When a student is considered to be able to make independent conclusions and decisions, think creatively, observe independently, apply the knowledge he has gained in practice, understand, know, express, and narrate the essence of the subject, and have an idea about the subject.
4	70-89,9	Good	When the student is considered to be able to observe independently, apply the knowledge he has gained in practice, understand, know, express, and narrate the essence of the subject, and has an idea about the subject
3	60-69,9	Satisfactory	When the student is found to be able to apply the knowledge he has gained in practice, understands, knows, can express, and narrate the essence of the subject, and has an idea about the subject.
2	0-59,9	Unsatisfactory	When it is determined that the student has not mastered the science program, does not understand the essence of the subject, and does not have an idea about the science.

Course assessment criteria and procedure

Assessment type	Total points allocated	Control (task) form	Distribution of points	Qualifying score
Current assessment	30 points	System tasks	20 points (divided by	18 points

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<tr><td></td><td></td><td>Student activity (in seminars, practical, laboratory classes)</td><td>10 points</td><td></td></tr>
<tr><td rowspan="2">Midterm assessment</td><td rowspan="2">20 points</td><td>Supervision: writing work</td><td>10 points</td><td rowspan="2">12 points</td></tr>
<tr><td>System tasks</td><td>10 points (divided by number of tasks)</td></tr>
<tr><td>Final assessment</td><td>50 points</td><td>Written assignment (5 questions)</td><td>50 points (10 points per question)</td><td>30 points</td></tr>
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* Note: 60% of the points allocated for current and intermediate control are allocated to independent work assignments. Independent work assignments are evaluated as system assignments through the electronic platform.
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<tr><td>Recommended Literature</td><td>
1. Das, B. M. Principles of Geotechnical Engineering, SI Edition. 10th ed. Cengage, 2022. ISBN 9780357420485.
2. Das, B. M. Principles of Foundation Engineering. 10th ed. Cengage, 2024. ISBN 9780357684658.
3. Mitchell, J. K., Soga, K., O'Sullivan, C. Fundamentals of Soil Behavior. 4th ed. Wiley, 2025. DOI 10.1002/9781119832348.
4. California Department of Transportation. Geotechnical Investigations. Geotechnical Manual. November 2023.
5. Loehr, J. E., Brown, D., Turner, J., Boeckmann, A. Acceptance Procedures for Structural Foundations of Transportation Structures. FHWA GEC 015, FHWA-HIF-22-024. April 2022.
6. Yamazoe, N., Tanaka, H., Nishimura, S., Hayashi, H. Analysis of long-term settlement of road embankment on peat ground during its service period. Soils and Foundations, 63(5), 2023, 101362. DOI 10.1016/j.sandf.2023.101362.
7. UNSW Sydney. CVEN3202 — Soil Mechanics. Term 3, 2022. Course outline, 12 September 2022.
8. UNSW Sydney. Official announcement of the QS World University Rankings 2027 results. June 2026.
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