Name of subject	HIGHWAY CONDITION ASSESSMENT (9 ECTS)
Subject/module code	**AYD27809**
Science taught semester (s).	7th and 8th semesters
Module leader	D. G‘ulomov, PhD, Acting Associate Professor, Department of Road Engineering
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours – 270 hours** **Contact hours – 108 hours** Lecture training hours – 48 hours Practical training hours – 60 hours **Independent education – 162 hours**
Course work	No
ECTS	9
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** to plan an investigation of a highway, its pavement, roadbed, drainage and roadside equipment. Interpret visual and instrument data, distinguish a recorded defect from its possible cause, and reach a diagnostic conclusion supported by evidence. **The objectives of teaching the subject** are to select survey locations, coverage, methods and safety measures. Record distress by type, severity and extent. Interpret profile, roughness, rutting, texture, friction, deflection and layer thickness using the relevant measurements. Assess the capabilities of deflectometers, radar and concrete testing methods. Check data quality, link observations in GIS and use image analysis to justify further investigation, monitoring or repair. **Learning outcomes:** 1. Define the asset or section, the diagnostic question, the sample and the safety plan. Justify a survey method in terms of the required accuracy and available resources. 2. Code distress in asphalt and concrete pavements from photographs and observation records. Determine extent and severity using the selected survey method. 3. Analyse profile, International Roughness Index (IRI), rut depth, texture and friction data, stating units, test conditions and measurement method. 4. Check loads and deflections in a falling weight deflectometer (FWD) or light weight deflectometer (LWD) record. Explain which layer data, temperature information and modelling assumptions a structural interpretation requires. 5. Distinguish measured signals, explanatory hypotheses and corroborating evidence in ground-penetrating radar (GPR) and concrete non-destructive testing (NDT). State the limits of each method. 6. Record defects in the roadbed, drainage, culverts and roadside equipment. Identify warning signs and justify referral for specialist inspection. 7. Use repeat measurements, a reference section and data checks to identify sources of error and explain the reliability and limits of the results. 8. Link defect records, coordinates, photographs and measurements in a spreadsheet or GIS. Verify errors in image-based detection. 9. Prioritise road sections using condition, risk, traffic and the supplied costs. Show how the priorities change with the selected method.

	10. Prepare a diagnostic report with reproducible calculations, a map, supporting evidence and limitations. Defend the conclusions individually.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions).** Topics: 1. Purpose and scale of condition assessment. 2. Survey planning. 3. Measurement quality. 4. Asphalt pavement distress. 5. Concrete pavement distress. 6. Visual distress surveys and the Pavement Condition Index (PCI). 7. Longitudinal profile and IRI. 8. Transverse profile. 9. Surface texture and friction. 10. Geometry and sight distance. 11. Roadbed and drainage. 12. Roadside equipment and interim findings. 13. Structural response. 14. Processing FWD data. 15. Backcalculation. 16. LWD and traffic-speed deflection measurements. 17. GPR principles. 18. GPR interpretation. 19. Concrete elements. 20. Geospatial evidence. 21. Computer vision. 22. Combining evidence. 23. Priorities and resources. 24. Final diagnostic conclusions. **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. Prepare a section record and formulate the diagnostic question. State which decision the investigation will support and what evidence is needed. 2. Prepare a sampling and route plan showing safe observation points, traffic constraints and weather limits. 3. Create an instrument and data log with date, location, units, settings and verification records. 4. Calculate differences and dispersion in repeat measurements and document the reason for flagging an invalid record. 5. Code asphalt pavement distress from photographs by type and severity using the assigned method.

	6. Calculate distress quantities and densities on an area or length basis and enter them in a register. 7. Mark concrete slab damage, joint condition and faulting on a sketch and link the entries to photographic evidence. 8. Check the PCI calculation for a supplied sample unit using the tables required by the method. Explain what the result represents. 9. Check the quality of longitudinal profile and IRI data and plot the results along the section. 10. Calculate rut depth and crossfall from a transverse profile using the specified reference method. 11. Compare texture and friction test records, documenting the methods and conditions for each. 12. Identify improper substitutions among straightedge, IRI, rut depth and friction results and explain the measurement involved in each. 13. Compare horizontal alignment, longitudinal profile and sight-distance measurements against the design requirement given in the brief. 14. Map evidence of settlement or moisture in the roadbed, side slopes and shoulders. 15. Record blockages, erosion and water marks in drainage features and culverts. Identify locations requiring further inspection. 16. Prepare a condition sheet for signs, markings and barriers, identifying requirements that the observations cannot verify. 17. Link the register, photographs and measurements in a spreadsheet or GIS and identify duplicate or missing records. 18. Defend the interim diagnostic report for semester 7 and plan how to obtain the outstanding evidence in semester 8. 19. Check units, sensor offsets and repeat readings in an FWD load–deflection record. 20. Plot the deflection basin, calculate the specified indices and compare sections tested under comparable conditions. 21. Apply the supplied load and temperature correction procedure, state its valid range and test the sensitivity of the result. 22. Compare supplied backcalculation solutions to show how layer thickness and modulus affect the result and its uniqueness. 23. Compare sample LWD, FWD and traffic-speed deflection records by test application, loading and depth of influence. 24. Estimate layer thickness from a GPR signal using the supplied calibration and compare the estimate with a core. 25. Test a moisture or void interpretation of a GPR anomaly against independent evidence and mark the area of uncertainty. 26. Interpret an ultrasonic pulse velocity (UPV), impact or thermography record for concrete and select a follow-up test. 27. Link a point cloud or image to the road register and check that the coordinates and time stamps agree. 28. Count true positives, false positives and false negatives in a labelled image test. Calculate precision and recall and examine the detection errors. 29. Compare two repair or investigation options using condition, risk and supplied costs. Test how the ranking changes with the assumptions. 30. Present and individually defend the integrated diagnostic report, its map, evidence and limitations. **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. Design an investigation programme. Define the sections, purpose, sampling, evidence requirements and safety plan, and justify the chosen methods. 2. Compile and cross-check a visual distress register for asphalt and concrete pavements. Include photographs, codes, quantities and the limits of PCI interpretation. 3. Check profile, IRI, rutting and friction data. Flag suspect records and produce a section plot with units, test conditions and a technical interpretation. 4. Map drainage, roadbed and roadside equipment observations. Record possible causes, warning signs and follow-up investigations. 5. Compare the inspection, non-destructive testing and decision process in CEE508 [11] with the needs of a local section. Document the adaptation in the interim report. 6. Analyse the 2023 paper on temperature correction of FWD deflection. Examine its data and model assumptions and assess transferability to the assigned section. 7. Develop alternative interpretations of GPR and concrete NDT records and prepare a plan for confirmatory testing. 8. Combine the register, FWD and GPR records and image evidence. Compare two options by risk and cost and test the sensitivity of the ranking to the weights. 9. Prepare and defend an individual final report containing calculations, a map, methods, findings, limitations and recommendations for further investigation and monitoring.
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 number of tasks)	18 points
		Student activity (in seminars,	10 points	

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<tr><td></td><td></td><td>practical, laboratory classes)</td><td></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. Papagiannakis, A. T., Masad, E. A. Pavement Design and Materials. 2nd ed. John Wiley & Sons, 2024. ISBN 9781394150175. www.wiley-vch.de
2. Chang, G. K., Gilliland, A. L., TaghaviGhalesari, A., Rada, G. R., Serigos, P. A., Simpson, A. L., Kouchaki, S. Successful Practices for Quality Management of Pavement Surface Condition Data Collection and Analysis: Final Report. FHWA, February 2023. FHWA-RC-23-0002. www.fhwa.dot.gov
3. Tobias, P., de León Izeppi, E., Flintsch, G., Katicha, S., McCarthy, R. Pavement Friction for Road Safety: Primer on Friction Measurement and Management Methods. Federal Highway Administration, February 2023. FHWA-SA-23-007. highways.dot.gov
4. ASTM International. ASTM D6433-24. Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys. 2024. DOI 10.1520/D6433-24. store.astm.org
5. ASTM International. ASTM D4694-09(2025). Standard Test Method for Deflections with a Falling-Weight-Type Impulse Load Device. 2025. DOI 10.1520/D4694-09R25. store.astm.org
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