Name of subject	HIGHWAY REPAIR AND MAINTENANCE TECHNOLOGIES (8 ECTS)
Subject/module code	**AYTST1808**
Science taught semester (s).	8th semester
Module leader	D. G‘ulomov, PhD, Acting Associate Professor, 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 education – 144 hours**
Course work	Individual coursework in semester 8. The 30 hours count towards the 144 independent study hours, and the 1 credit counts towards the 8 module credits
ECTS	8
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** to select a repair or maintenance method suited to the condition of each highway element and the conditions on site. Justify the selection with a method statement, material and equipment calculations, a work schedule and a quality control plan. **The objectives of teaching the subject** are to use diagnostic evidence to select treatments for asphalt and concrete pavements. Compare surface treatments, milling, resurfacing and recycling. Plan work on pavement bases, shoulders, drainage, road furniture and structures. Calculate summer and winter service resources and incorporate work-zone safety, quality checks, costs and environmental requirements into the chosen method. **Learning outcomes:** 1. Explain the applicable classification of maintenance and repair works and justify a work category from the asset condition and service objective. 2. Use defects, structural condition, water and traffic conditions to define treatment requirements and identify any further investigation needed. 3. Select compatible materials and methods for cracks, potholes, surfaces and pavement layers, and identify the limits of each treatment. 4. Specify the operations, checks and reopening conditions for asphalt milling, resurfacing, surface treatments and recycling. 5. Select a concrete pavement repair method for joint defects, localised damage or surface deterioration and specify the inspection and acceptance evidence. 6. Relate roadbed, shoulder, drainage and road furniture maintenance to pavement condition and drainage patterns. Identify bridge and culvert works that require specialist oversight. 7. Plan summer and winter maintenance operations, equipment routes, material application and checks on completed work. 8. Calculate work quantities, material mass, equipment output, crew requirements and duration, checking the units throughout. 9. Include the work-zone layout, temporary traffic management, worker safety and environmental protection in the method statement. 10. Distinguish incoming material, in-process and acceptance checks, and verify test results and as-built records against the specified criteria.

	11. Compare two methods by cost, resources, service life and environmental impact, stating the limits of the data and calculations. 12. Defend the semester 8 course assignment using drawings and calculations that connect the chosen method, quantities, resources, schedule and quality checks.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions).** Topics: 1. Repair and maintenance objectives. 2. From diagnosis to treatment. 3. Repair materials and trial sections. 4. Work-zone setup. 5. Crack filling and sealing. 6. Localised pothole repairs. 7. Surface dressing and chip seals. 8. Slurry seal and microsurfacing. 9. Milling and resurfacing. 10. Thin overlays and structural strengthening. 11. Hot recycling and reclaimed asphalt pavement (RAP). 12. Cold recycling and layer rehabilitation. 13. Concrete joint and localised repairs. 14. Concrete surface restoration. 15. Base and drainage repairs. 16. Shoulder, roadbed and slope maintenance. 17. Maintenance at bridges and culverts. 18. Summer maintenance. 19. Winter maintenance. 20. Road furniture maintenance. 21. Equipment and work scheduling. 22. Quality control and acceptance. 23. Costs, life cycle and environmental effects. 24. Digital records and service outcomes. **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. Classify defects and compile a work list identifying each asset element, maintenance or repair category, justification and applicable classification. 2. Compare two treatments in a table showing the diagnostic evidence, likely cause, conditions of use and further investigation needed. 3. Prepare a material compatibility and site-readiness checklist covering product records, surface and weather conditions, trials and acceptance requirements.

	4. Draw the work zone, including work frontage, temporary traffic, pedestrian and equipment routes and access points. Add an inspection checklist. 5. Calculate crack sealant mass from crack length, working cross-section, material density and justified losses. Prepare the sequence of operations. 6. Prepare a hot- or cold-mix pothole repair method statement covering volume, compacted mass, material haulage and checks before reopening. 7. Use area and trial application rates to balance binder and aggregate for surface dressing. Tabulate equipment calibration and quality checks. 8. Compare slurry seal and microsurfacing by defect condition, mix composition, placement requirements and reopening criteria. 9. Calculate milling and replacement quantities from cross-sections. Reconcile recovered material, new mix mass, haulage and layer quantities. 10. Compare a thin overlay with strengthening against functional and structural needs. Record the specified design thickness, material and joint detail. 11. Balance RAP and virgin materials by dry mass, correct for moisture and state the binder assumptions and verification checks. 12. Plan cold recycling. Record depth, area, specified binder application rate, production rate and controls on compaction and curing. 13. Prepare a concrete joint or localised repair method statement showing damage, depth of repair, quantity, material compatibility and reopening evidence. 14. Measure concrete surface restoration area, calculate equipment and waste-handling requirements and plan profile and skid resistance checks. 15. Quantify base and drainage repairs. Record the moisture source, excavation, replacement layer, filter and outlet quantities, and acceptance checks. 16. Prepare a shoulder and slope restoration schedule of works from cross-sections, earthwork quantities, flow paths and erosion protection requirements. 17. Prepare a work order for cleaning, approach repairs and drainage at a bridge or culvert. Refer identified structural damage to a specialist. 18. Plan summer cleaning and vegetation control by area or length, equipment route, waste disposal location, service frequency and outcome checks. 19. Calculate winter maintenance resources from route, snow conditions, equipment cycle and calibrated application rate. Report material mass and environmental constraints. 20. Prepare a work sheet for restoring signs, markings or barriers. Record the elements, quantities, materials, preparation and performance checks. 21. Size the crew and equipment and produce a time–location schedule using the controlling operation, actual productivity, shifts and haulage limits. 22. Prepare a quality control plan identifying each operation, source of the criterion, test or record, responsible person and corrective action. 23. Compare the life-cycle costs of two methods using quantities, resource requirements and dated prices. Test sensitivity to discounting and service life. 24. Audit the final method and as-built records. Report whether the map, quantities, material batches, photographs, inspection records and schedule agree. **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. Compare treatment selection for two road sections in different conditions. Justify each choice from diagnostic evidence, likely cause and treatment limits. 2. Prepare a method statement for crack or pothole repair by combining the individual calculations for materials, operations and quality checks. 3. Assess the suitability of surface dressing, slurry seal and microsurfacing for the assigned section using product documentation and site conditions. 4. Calculate quantities and material balances for milling, resurfacing and RAP options. Explain moisture corrections and assumptions about the recovered binder. 5. Compare joint repair, localised repair and surface restoration for concrete pavement. Justify quality checks and traffic reopening criteria. 6. Select a method for the base, drainage, shoulder or approaches to a structure. Quantify the work and identify tasks requiring specialist oversight. 7. Develop a summer or winter service plan. Agree the route, equipment cycle, material application rates and verification procedure. 8. Prepare a work-zone, quality control and as-built record sheet. Verify calculations, photographs, test results and location data. 9. Use the 2023 winter pothole repair study [7] to compare the productivity, service duration and cost of two methods. Assess transferability to local conditions. 10. For the course assignment, document the section, defects and work category. Select two methods, list operations and calculate work quantities. 11. For the course assignment, calculate materials, equipment, crews, duration and costs. Compare environmental effects. 12. Allocate 6 hours to the course assignment method statement, programme, quality checks, safety, A1 drawing sheet and defence, and 6 hours to checking the full portfolio.
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

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<tr><td></td><td>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.</td></tr>
<tr><td>Criteria for assessing student knowledge</td><td>
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<tr><th>5 grade</th><th>100 points</th><th></th><th>Assessment criteria</th></tr>
<tr><td>5</td><td>90-10</td><td>Excellent</td><td>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.</td></tr>
<tr><td>4</td><td>70-89,9</td><td>Good</td><td>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</td></tr>
<tr><td>3</td><td>60-69,9</td><td>Satisfactory</td><td>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.</td></tr>
<tr><td>2</td><td>0-59,9</td><td>Unsatisfactory</td><td>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.</td></tr>
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<tr><td>Course assessment criteria and procedure</td><td>
<table>
<tr><th>Assessment type</th><th>Total points allocated</th><th>Control (task) form</th><th>Distribution of points</th><th>Qualifying score</th></tr>
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<tr><td rowspan="2">Current assessment</td><td rowspan="2">30 points</td><td>System tasks</td><td>20 points (divided by number of tasks)</td><td rowspan="2">18 points</td></tr>
<tr><td>Student activity (in seminars, practical, laboratory classes)</td><td>10 points</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. Cabinet of Ministers of the Republic of Uzbekistan. Resolution No. 901 of 30 December 2024, Annex 2. Classification of highway repair and maintenance works. Version of 25 August 2026 cited in the syllabus. lex.uz
2. Smith, K., Grogg, M., Ram, P., Smith, K., Harrington, D. Concrete Pavement Preservation Guide. 3rd ed. National Concrete Pavement Technology Center, Iowa State University, August 2022. www.cptechcenter.org
3. Federal Highway Administration. Pavement Preservation Checklist Series. 2019 collection: Crack Treatment, Chip Seal, Thin Hot Mix Asphalt Overlay, Microsurfacing, Slurry Seal, HMA Asphalt Patching and related checklists. www.fhwa.dot.gov
4. Schaefer, K., Carlson, M., Johnson, C. Minnesota Snow and Ice Control Handbook for Snowplow Operators. MnLTAP, University of Minnesota, January 2022. Report 2022RIC01. rosap.ntl.bts.gov
5. Rogers, M., Enright, B. Highway Engineering. 4th ed. John Wiley & Sons, 2023. ISBN 9781119883302. www.wiley-vch.de
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