Name of subject	HIGHWAY CONSTRUCTION AND RECONSTRUCTION (10 ECTS)
Subject/module code	**AYQRQ16710**
Science taught semester (s).	6th and 7th 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 – 300 hours** **Contact hours – 120 hours** Lecture training hours – 48 hours Practical training hours – 48 hours Laboratory classes – 24 hours **Independent study – 180 hours**
Course work	Individual coursework in semester 6 and an individual course project in semester 7. Each accounts for 30 of the 90 independent hours and 1 of the 5 credits in its semester
ECTS	10
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** to use design information and evidence of existing road condition to select construction and reconstruction methods. They coordinate quantities, equipment, resources and time, and use quality records to justify how the work will be carried out. **The objectives of teaching the subject** are to plan site preparation, earthworks, drainage, base layers and asphalt and concrete paving. Select equipment and production rates, prepare method statements, and check material properties, moisture, compaction, geometry and strength. Plan reconstruction around live traffic, drainage and the interface between existing and new layers. Evaluate recycling options, resource needs, costs and construction records. **Learning outcomes:** 1. Explain construction and reconstruction stages, the purpose of design documents, method statements and as-built records, and the applicable regulatory requirements. 2. Calculate quantities and reconcile soil volumes in their in-situ, loose and compacted states to establish material and haulage balances. 3. Select a balanced equipment fleet and production rate using equipment outputs, available work frontage and the limiting operation. 4. Justify a method statement for constructing the roadbed in layers, controlling moisture, compacting the soil and providing drainage. 5. Select the construction method, sequence and quality-control points for granular and stabilised bases, asphalt layers and concrete pavement. 6. Check laboratory and field results against the test method, units and specified acceptance criteria. Record nonconformities and corrective action. 7. Assess investigation data for an existing road and justify a reconstruction option and any additional investigations. 8. Coordinate traffic staging, road widening, the interface between existing and new layers, and drainage renewal. 9. Compare milling, recycling and geosynthetic options against technical requirements, resource needs and quality evidence. 10. Integrate quantities, resources, programme and costs. Compile consistent quality and as-built records for acceptance of the works.

	11. Defend the semester 6 course assignment using calculations and drawings to justify roadbed construction methods, fleet selection and work organisation. 12. Defend the individual semester 7 reconstruction project, justifying the construction method, staging, quality plan and resource plan.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions).** Topics: 1. Construction processes and records. 2. Preparation and supply. 3. Workflow, equipment and resources. 4. Earthworks and material balance. 5. Excavation and haulage in cuttings and borrow pits. 6. Embankment construction and compaction. 7. Roadbeds on weak soils and in difficult terrain. 8. Drainage and culvert construction. 9. Granular bases. 10. Stabilised bases. 11. Asphalt paving. 12. Concrete paving. 13. Investigations for reconstruction. 14. Reconstruction options. 15. Traffic management in work zones. 16. Road widening. 17. Renewing drainage and utilities. 18. Milling and asphalt recycling. 19. Asphalt overlays. 20. Concrete pavement reconstruction. 21. Geosynthetics and protective layers. 22. Process and acceptance control. 23. Programme, resources, costs and environmental performance. 24. As-built records and handover. **II. Instructions and recommendations for organizing laboratory exercises** Report the method, instrument, specimen or field location, raw readings, calculation, acceptance criterion and conclusion. Apply QR 06.03-23 [1] with the test method specified in the assignment. Use pre-prepared samples for lengthy drying or curing. Where equipment is unavailable, analyse partner laboratory results or instructor-supplied observations. Identify the source of each result and record separately the measurements the student personally took. Topics: 1. Determine soil or material moisture content. Record sample ID, masses, units and the moisture calculation for incoming material inspection. 2. Obtain and analyse standard compaction results. Plot dry density against moisture content and determine optimum moisture content and maximum dry density. 3. Check field density and degree of compaction. Record the location, volume, mass and moisture content, and compare the result with a reference obtained by the corresponding method. 4. Check a granular base. Record grading, layer thickness and surface regularity and compare the measurements with the specified acceptance criteria. 5. Assess asphalt laying and compaction records. Use the supplied temperature log, specimen density and layer thickness to reach a quality conclusion.

	6. Examine fresh concrete and control specimens. Record mix characteristics, specimen preparation and curing, and results for specimens prepared in advance. 7. Describe existing pavement samples. Prepare a reconstruction data sheet identifying the layer, thickness, defects and sampling location. 8. Examine milled pavement material. Record RAP sample identity, grading, moisture content and uniformity. 9. Examine prepared stabilised or recycled base specimens. Analyse composition, density, moisture content and the supplied strength results. 10. Evaluate interlayer bond evidence from a prepared specimen or test dataset. Describe the surface, binder, failure mode and limits of the method. 11. Measure surface regularity, slope and geometry. Record instrument, reference point and readings, then compare them with the specified tolerances. 12. Audit the final quality and as-built records. Trace the test report to its lot, location, test and acceptance criterion, and log discrepancies. **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. Map the construction sequence and documentation. Link each design requirement to the operation, inspection and document to be submitted. 2. Prepare a schedule of quantities showing how sections, layer dimensions, lengths and areas determine each quantity and its units. 3. Calculate machine output and workflow. Use cycle time, utilisation and the limiting operation to establish a balanced production rate. 4. Reconcile in-situ, loose and compacted soil volumes in a table of earthwork quantities, sources and haul movements. 5. Select an excavation and haulage fleet. Check haul distance, loading cycle, number of vehicles and idle time. 6. Draw up a compaction plan showing lift thickness, soil moisture, trial section, roller passes and control points. 7. Compare construction on weak soils in a table covering water conditions and the suitability of replacement, staged construction and geosynthetics. 8. Write a drain or culvert method statement covering the trench, bedding, installation, backfill and sequence of quality checks. 9. Calculate granular base material and water requirements from compacted volume, density and moisture. Produce a delivery schedule. 10. Prepare a stabilised-base production plan showing specified proportions, batching, working time, compaction and curing. 11. Select the asphalt paving equipment and rate. Tabulate and balance the outputs of the plant, haulage vehicles, paver and rollers.

	12. Prepare a concrete paving and jointing plan showing delivery, compaction, joint cutting, curing and quality-control points. 13. Check the existing road data and compile a site record of defects, layers, water, loading and outstanding investigations. 14. Compare reconstruction alternatives and justify a choice using technical performance, construction constraints, duration and cost. 15. Prepare a traffic staging diagram showing work areas, temporary routes, access points and the order in which areas are released. 16. Plan road widening and the tie-in of new fill. Draw the cross-section and benches, showing controls for moisture, compaction and settlement. 17. Prepare a drainage renewal method statement for work under live traffic, covering temporary water diversion, construction stages and inspection before covering. 18. Balance milled material and RAP quantities, accounting for layers removed, moisture, suitability, stockpiling and the amount available for reuse. 19. Select overlay layers and bonding arrangements. Produce a control sheet for surface preparation, tack coat application, joints and layer thickness. 20. Set out the slab replacement sequence from cutting and removal through base preparation, load transfer and concreting to the reopening criterion. 21. Prepare a geosynthetic installation method statement covering the substrate, material orientation, overlaps, protection and checks on the cover layer. 22. Develop a sampling and acceptance plan identifying the lot, characteristic, test method, acceptance criterion and nonconformity record. 23. Develop a resource-loaded programme showing activity dependencies, durations, equipment demand and material requirements. 24. Defend a construction plan for reconstruction. Submit the selected option, quantities, stages, resources, quality plan and as-built documentation requirements. **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. Compile a site record of baseline data, design requirements and construction documents. 2. Calculate the earthworks production rate and size the excavation, haulage and compaction fleet. Check which operation limits output. 3. Calculate material requirements and production rates for the base and surfacing of a new road and specify process controls. 4. Prepare a plan for material checks, compaction control, geometric checks, safety and environmental control. 5. For the course assignment, prepare the earthworks balance, quantities, equipment calculations and earthworks method statement. 6. Complete the course assignment with the programme, resource and quality plans, drawing and explanatory report, and defend the work 7. Check the existing road's layer, defect, water, loading and geometric data. Compile a reconstruction site record. 8. Compare reconstruction options by technical performance, construction stages, traffic impacts and resource requirements.

	9. Develop a staging diagram that maintains traffic and water flow and details the tie-in between existing and new construction. 10. Compare milling and recycling options using material balances, test evidence, costs and resource needs. 11. For the course project, select the reconstruction option, calculate quantities, choose the construction method and develop construction sequence diagrams. 12. Complete the course project with the programme, traffic and quality plans, drawings, as-built record requirements and explanatory report, and defend it.
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, practical, laboratory classes)	10 points	
Midterm assessment	20 points	Supervision: writing work	10 points	12 points
		System tasks	10 points (divided by number of tasks)	
Final assessment	50 points	Written assignment (5 questions)	50 points (10 points per question)	30 points

* 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.

Recommended Literature	1. QR 06.03-23. Highways. Construction regulations. Approved by Order No. 2 of the Minister of Construction and Housing and Communal Services, 5 January 2024. lex.uz 2. Federal Highway Administration. Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects. FP-24, 2024. Errata, 16 October 2026. highways.dot.gov 3. Rogers, M., Enright, B. Highway Engineering. 4th ed. John Wiley & Sons, 2023. ISBN 9781119883302. www.wiley-vch.de 4. Papagiannakis, A. T., Masad, E. A. Pavement Design and Materials. 2nd ed. John Wiley & Sons, 2024. ISBN 9781394150175. www.wiley-vch.de 5. Hand, A. J., Aschenbrener, T. Asphalt Pavement Recycling Technologies. TechBrief. FHWA, July 2023. FHWA-HIF-23-036. rosap.ntl.bts.gov 6. Zaumanis, M., Poulikakos, L., Arraigada, M., Kunz, B., Schellenberg, U., Gassmann, C. Asphalt recycling in polymer modified pavement: A test section and recommendations. Construction and Building Materials, 409, 2023, 134005. DOI 10.1016/j.conbuildmat.2023.134005.