Name of subject	ROAD CONSTRUCTION MATERIALS (8 ECTS)
Subject/module code	**YQM13408**
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 – 24 hours Practical training hours – 48 hours Laboratory classes – 24 hours **Independent study – 84 hours**
Course work	No
ECTS	8
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** to learn to evaluate, test and select materials for roads, aerodromes and highway structures, and to manage their quality. The module covers soils, rock and aggregate, mineral binders, bitumen, asphalt mixtures, cement concrete, emulsions, stabilising materials, geosynthetics and recycled resources. **The objectives of teaching the subject** are to relate the function of each material in a road structure to its properties, test results, service conditions and quality requirements. Take and prepare representative samples. Test aggregates, soils, mineral binders, bitumen, asphalt mixtures and concrete, and interpret the results. Calculate particle-size distributions and mix proportions. Assess density, voids, moisture content, strength, deformation and durability. Select materials for the climate and traffic loading, plan quality control and quality assurance (QC/QA) in production and construction, and justify the use of reclaimed asphalt pavement (RAP), recycled concrete aggregate (RCA), rubber and mineral additions. Apply laboratory safety procedures, check measurement reliability and maintain technical records. **Learning outcomes:** 1. Explain the functions, classification, principal properties and limits of use of materials in pavement layers and components of transport structures. 2. Plan how to obtain, reduce, store and prepare a representative sample for laboratory testing, meeting the requirements for measurement accuracy and reliability. 3. Calculate and evaluate test results for rock and aggregate, including grading, density, water absorption, particle shape, strength and resistance to wear. 4. Classify soils and granular base materials and interpret moisture–density relationships, compaction and California bearing ratio (CBR) results. 5. Select cement, lime, mineral additions, chemical admixtures and concrete constituents. Calculate proportions for a simple concrete mix and evaluate the properties of fresh and hardened concrete. 6. Select suitable paving bitumen and emulsions using indicators of consistency, viscosity, temperature susceptibility, ageing and adhesion. 7. Perform basic asphalt mix calculations for aggregate grading, density, air voids, voids in mineral aggregate (VMA), voids filled with asphalt (VFA), stability and binder content.

	8. Justify the conditions for stabilising soils and base materials with cement, lime, bitumen or emulsion, and for using geosynthetics. 9. Compare the benefits, risks, variability and environmental performance of RAP, RCA, rubber, industrial mineral additions and other recycled materials. 10. Prepare a test report, material data sheet, technical specification and QC/QA plan. Identify nonconformities in the results and give a reasoned engineering conclusion.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions).** Topics: 1. Introduction to road materials. Interactions between materials, structures and the environment. 2. Natural stone and mineral aggregates. Rock origins, crushing and screening into size fractions. 3. Soils and granular base materials. 4. Mineral binders. 5. Cement concrete for roads and structures. 6. Organic binders. 7. Asphalt mixtures. 8. Bitumen emulsions, cold mixes and surface treatments. 9. Stabilised materials and geosynthetics. 10. Recycled and secondary materials. 11. Durability and sustainability. 12. Materials production and quality management. **II. Instructions and recommendations for organizing laboratory exercises** The twelve laboratory exercises follow the institute's 2026 laboratory guide [5]. Prepare specimens in advance or use prior observations for curing, drying, soaking and extended monitoring. Identify the operations completed during the two-hour class. The test record must identify the specimen, lot, method, instrument and verification status, temperature, time, raw measurements and result. If specialist equipment is unavailable, analyse supplied test data. Follow the approved laboratory procedures for hot bitumen, solvents and presses. Distinguish hydrostatically determined aggregate density from the true density of pore-free mineral matter, and viscosity from adhesion. Topics: 1. Laboratory safety, equipment and sample identification. Obtain, reduce and label a representative sample. Submit its data sheet and laboratory log. 2. Determine the grading of a rock aggregate by sieve analysis. Submit a table of material retained and a grading curve. 3. Measure aggregate density and water absorption. Submit a calculation sheet identifying the sample condition and test method. 4. Determine soil grading and physical properties. Submit a test report recording moisture content, grading and the method used. 5. Obtain or analyse standard compaction and CBR test data. Plot the moisture–dry density curve and state the conditions under which the CBR result was obtained. 6. Assess the standard consistency, setting times and soundness of cement. Report observations, previously prepared results and conclusions. 7. Measure the slump and density of fresh concrete and prepare test specimens. Submit the fresh-concrete test record and specimen identification codes.

	8. Determine the compressive strength of a previously cured concrete cube. Record dimensions, load, strength and mode of failure. 9. Measure bitumen penetration. Report test temperature, load, duration and repeat readings. 10. Measure the softening point of bitumen by the ring-and-ball method. Record the observed temperatures and the calculated softening point. 11. Measure bitumen ductility and viscosity. For each property, report the test method, temperature and units separately. 12. Determine the binder content of an asphalt mixture and the grading of the recovered aggregate. Submit a mass balance and grading report. **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. Create a matrix of material functions and requirements for each pavement layer. 2. Prepare a plan for sampling a material lot, reducing the sample and selecting the required tests. 3. Calculate aggregate sieve-analysis results and plot the grading curve. 4. Calculate the proportions of two or three aggregate fractions needed to achieve a specified grading. 5. Select a suitable application for an aggregate from its density, water absorption, crushing or abrasion resistance, and particle shape. 6. Classify soil and granular material by grading and plasticity. 7. Use a moisture–dry density curve to determine optimum moisture content and maximum dry density. Evaluate field compaction control results. 8. Compare cement and mineral additions against technical requirements and select a water–cement ratio. 9. Use a simplified method to proportion a concrete mix for a given strength and workability. 10. Correct the concrete batch quantities for aggregate moisture content and water absorption. 11. Analyse concrete strength results statistically and compare them with the acceptance criteria. 12. Use bitumen test results to assess consistency and temperature susceptibility and select a suitable grade for the application. 13. Select conventional or polymer-modified bitumen for the climate, loading and expected type of distress. 14. Calculate maximum theoretical specific gravity (Gmm), bulk specific gravity (Gmb), air voids, VMA and VFA for an asphalt mixture. 15. Determine optimum binder content from Marshall stability, flow, density and air-void results. 16. Analyse the main elements of Superpave, including aggregate structure, binder grade, gyratory compaction and performance criteria.

	17. Select a bitumen emulsion and calculate the material application rate for a surface treatment. 18. Calculate material quantities and the volume of asphalt mixture to be produced for a specified road section. 19. Plan trial dosages of cement, lime or emulsion for stabilising a soil or granular base. 20. Select a geosynthetic for separation, filtration, reinforcement or waterproofing. 21. Develop a preliminary recycled asphalt mix design, specifying RAP content, rejuvenator dosage and proportions of virgin materials. 22. Compare RCA, rubber, ash, slag and mineral additions using technical, environmental and logistical criteria. 23. Prepare a control chart, report the mean and variability, specify conformity limits and document a decision on nonconforming material. 24. Defend an integrated materials project. Evaluate the test results, technical specification, QC/QA plan, and technical and economic justification. **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. Map national and international standards for road construction materials. Submit a standards matrix. 2. Investigate local sources of stone, sand and mineral filler and evaluate their properties and transport logistics. Submit a material-source data sheet. 3. Develop laboratory record forms and a calculation template for aggregate tests. Submit a test record form and spreadsheet. 4. Select paving bitumen or a modified binder for the specified climate and traffic load. Submit a technical justification and comparison table. 5. Complete a short project on concrete constituents, mix proportions and durability requirements. Submit calculations and a specification. 6. Develop an incoming, in-process and acceptance inspection plan for a materials production or construction process. Submit the QC/QA plan. 7. Calculate the grading and volumetric properties of an asphalt mixture. Submit the mix design file. 8. Compare three options for stabilising weak soil or a granular base. Submit an analysis of the alternatives. 9. Investigate a real application of road materials incorporating RAP and RCA. Submit a case study and presentation, critically examining the materials and test conditions reported in reference [7]. 10. Check a geosynthetic or innovative material's product data against the engineering requirements. Submit a technical selection sheet. 11. Compare conventional and recycled materials in terms of service life, energy, transport and waste. Submit a simplified life-cycle assessment and life-cycle cost analysis (LCA/LCCA) table. 12. Complete the integrated materials assignment. Present a material data sheet, test results and technical requirements, then draw a conclusion on quality control. Submit and defend a technical report.
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.

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<tr><td></td><td>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.</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</td></tr>
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<tr><td></td><td></td><td></td><td>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>
<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. Mamlouk, M. S., Zaniewski, J. P. Materials for Civil and Construction Engineers. 4th ed. Pearson, ©2022
2. Papagiannakis, A. T., Masad, E. A. Pavement Design and Materials. 2nd ed. John Wiley & Sons, 2024. 656 p. eBook ISBN 9781394150182.
3. Gross, J., Weiss, J., Ley, T., Taylor, P., Weitzel, N., Van Dam, T., Smith, G., Jones, C. Performance-Engineered Concrete Paving Mixtures. Iowa State University, Institute for Transportation, 2022. InTrans Project 17-629.
4. Federal Highway Administration. Asphalt Pavement Recycling Technologies. TechBrief. FHWA-HIF-23-036. July 2023.
5. Jizzax politexnika instituti. Yo‘l qurilishi materiallari. Laboratoriya ishlarini bajarish bo‘yicha uslubiy ko‘rsatma. YQM13408. Jizzax, 2026. 12 ta laboratoriya ishi, 24 akademik soat.
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6. Federal Highway Administration. Resource Responsible Use of Reclaimed Asphalt Pavement in Asphalt Mixtures. TechBrief. FHWA-HIF-22-003. July 2021.
7. 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.
8. UNSW Sydney. CVEN9824 Advanced Materials Technology. Term 2, 2023. Course Outline. 29 May 2023.
9. UNSW Sydney. UNSW claims Australia's top spot for the first time in preeminent world university rankings. 2026. QS World University Rankings 2027.