Name of subject	HIGHWAY SERVICE AND OPERATING CHARACTERISTICS (4 ECTS)
Subject/module code	**AYTFS2504**
Science taught semester (s).	5th semester
Module leader	Professor Inomjon G‘aniyev, Candidate of Technical Sciences, Head of the Department of Road Engineering
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours – 120 hours** **Contact hours – 48 hours** Lecture training hours – 24 hours Practical training hours – 24 hours **Independent education – 72 hours**
Course work	No
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** to use traffic observations, road geometry and pavement condition evidence to assess how a highway carries traffic and supports reliable travel, comfort and safety. Identify where improvements are needed and justify them. **The objectives of teaching the subject** are to calculate traffic volume, composition, speed, density and capacity. Analyse travel time, delay and reliability. Examine how sight distance, cross-section and horizontal and vertical alignment affect operations. Interpret roughness, rutting, texture, friction and structural condition separately. Relate safety and transport costs to the conditions observed and prepare a section performance profile and technical report documenting data quality and the limits of the methods used. **Learning outcomes:** 1. Group highway performance measures by traffic operations, travel time, geometry, pavement condition and safety. Explain what each measures and how the groups are related. 2. Use traffic observations to calculate volume, vehicle composition and variation over time. Distinguish hourly from daily traffic measures. 3. Apply the speed–flow–density relationship under stated assumptions and explain the difference between time-mean and space-mean speed. 4. Assess capacity and quality of service using a method suited to the highway facility and given conditions. Identify the source of the assessment criteria. 5. Compare travel time, delay, percentile travel times and reliability measures. Document the reference condition, observation period and sample limitations. 6. Check road geometry and sight distance against the stated requirements. Identify constraints and locations that need further investigation. 7. Assess roughness (IRI), rut depth, texture and friction separately, recording the test method, speed, moisture conditions, units and date for each result as applicable. 8. Use diagnostic evidence to assess structural condition and traffic exposure data to interpret safety records. State what the evidence supports in each case. 9. Compare two improvement options for the assigned section using travel time, costs, resources and road user conditions.

	10. Prepare a technical report with a section performance profile, calculation sheets, supporting evidence and limitations. Defend the chosen option individually.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions).** Topics: 1. Highway performance measures. 2. Traffic flows and observations. 3. Speed, flow and density. 4. Capacity and quality of service. 5. Travel time and reliability. 6. Geometry and operating conditions. 7. Pavement roughness and ride comfort. 8. Texture, friction and water. 9. Structural condition in service. 10. Safety and temporary restrictions. 11. Transport costs and improvement options. 12. Combined assessment of a road section. **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 data sheet. Identify the road type and section limits and tabulate the sources, dates, units and gaps in geometry, traffic and condition data. 2. Calculate traffic flow and composition. Tabulate results by observation interval, direction, vehicle group and peak period, with consistent units. 3. Analyse speeds, flow and density. Report time-mean and space-mean speeds and calculate q, k or u where the observations support the relationship. State data limitations. 4. Assess capacity and quality of service. Use the method specified for the facility type, state its assumptions, compare demand with capacity and cite the criterion used in the conclusion. 5. Analyse a travel-time series. Report the mean, median, upper percentile, delay and reference condition, and explain the selected reliability measure. 6. Check geometry and sight distance. Extract parameters from the plan and profile or supplied measurements, compare them with the applicable criteria and map the constraints. 7. Plot roughness and rutting along the road. Associate IRI, profile or rut-depth observations with location, method, unit, date and a data-quality flag.

	8. Compare friction and texture results. Record the instrument, test speed, water conditions, surface characteristics and assessment criterion in a comparison table. 9. Interpret structural diagnostics. Document defects, deflection, pavement layers and environmental conditions, identify further investigation needs and state model limitations. 10. Evaluate safety records against exposure. Compare sections and periods using vehicle travel and crash records, and analyse work-zone or sight-distance hazards. 11. Compare two improvement options. Tabulate time, traffic, costs and resources, giving the price date, analysis boundary and sensitivity to assumptions. 12. Complete and defend the section report. Submit the performance profile, a chart along the alignment, calculations, evidence, limitations and a monitoring recommendation **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. Prepare traffic observations for analysis. Check volume, vehicle composition, speed, observation intervals and data quality, and justify the units and comparison period. 2. Assess section capacity and travel times as a group. Select a method appropriate to the facility and check the reference condition, percentile calculations and service criterion. 3. Build a performance profile from geometry, roughness, rut depth and friction data. Document observation conditions and limitations. 4. Analyse evidence on structural condition and safety. Relate defects to environmental conditions, account for traffic exposure and justify further investigation where needed. 5. Review the 2023 study on IRI and seated-person vibration as a group. Assess how vehicle type, speed and sensor location affect interpretation for the assigned section. 6. Prepare and individually defend the final section report. Include calculation sheets, a chart along the alignment, two improvement options, data limitations and a monitoring recommendation.
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

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<tr><td></td><td>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>
<table>
<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>
<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. Ministry of Construction and Housing and Communal Services of Uzbekistan. SHNQ 2.05.02-23, Highways. Design Requirements. Order No. 01/2-61 of 23 August 2024. Effective date cited in the syllabus: 14 October 2024. lex.uz
2. National Academies of Sciences, Engineering, and Medicine. Highway Capacity Manual 7th Edition: A Guide for Multimodal Mobility Analysis. The National Academies Press, Washington, DC, 2022. DOI 10.17226/26432.
3. Rogers, M., Enright, B. Highway Engineering. 4th ed. John Wiley & Sons, 2023. ISBN 9781119883302. www.wiley-vch.de
4. 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
5. Papagiannakis, A. T., Masad, E. A. Pavement Design and Materials. 2nd ed. John Wiley & Sons, 2024. ISBN 9781394150175. www.wiley-vch.de
6. 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
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