Name of subject	HIGHWAY DESIGN (12 ECTS)
Subject/module code	**AYL15612**
Science taught semester (s).	5th and 6th 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 – 360 hours** **Contact hours – 144 hours** Lecture training hours – 60 hours Practical training hours – 60 hours Laboratory classes – 24 **Independent study – 216 hours**
Course work	Semester 5. Individual assignment, 30 hours of independent study and 1 credit within the semester workload
ECTS	12
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** to develop the ability to design the alignment, plan, longitudinal profile and cross-sections of a road section in response to traffic demand, site conditions, safety and applicable design criteria. Students build a digital model, check their designs and justify their decisions. **The objectives of teaching the subject** are to Analyse the design brief and survey data. Forecast traffic and select the road category and design parameters. Compare route alternatives and calculate horizontal and vertical curves, superelevation, widening and sight distances. Coordinate earthworks, earthwork quantities, drainage and junction layouts. Provide for pedestrians, cyclists and public transport users. Check design quality in CAD and GIS, and compare quantities and life-cycle costs. **Learning outcomes:** 1. Explain the design stages, identify the input data and determine which local design requirements apply. 2. Use traffic data to estimate future traffic volumes and design flow. Justify the road category, design speed and design vehicle. 3. Develop alternative route corridors that account for terrain, geotechnical, drainage and land-use constraints. Compare them using evidence. 4. Calculate the geometry of circular and transition curves, superelevation, widening and sight distances for the chosen design conditions. 5. Design the longitudinal profile, grade line and vertical curves. Check gradients, elevations and the spatial coordination of the alignment. 6. Select an appropriate cross-section and earthworks configuration. Calculate earthwork volumes and the cut-and-fill balance from cross-sections. 7. Assess catchment conditions and justify preliminary road drainage and cross-drainage solutions. 8. Lay out intersections, connecting roads, public transport stops and pedestrian and cycle facilities to suit vehicle envelopes, sight distance and operating conditions. 9. Create terrain, alignment, profile, corridor and cross-section models in CAD and GIS. Extract drawings and quantities from the digital model.

	10. Evaluate design alternatives against safety, environmental and social impacts, construction and operating requirements, and life-cycle costs. 11. Prepare and individually defend the geometric design, calculations and drawings for the assigned road section in the semester 5 course design assignment. 12. Check consistency across calculations, drawings and the digital model. Submit a design package identifying parameter sources, limitations and individual contributions
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions).** Topics: 1. Design stages and the project brief. 2. Road function and category. 3. Traffic flow and future demand. 4. The design vehicle and human factors. 5. Speed and sight distance. 6. Site conditions and design data. 7. Route corridors and alternatives. 8. Tangents and circular curves in plan. 9. Transition curves. 10. Superelevation, widening and transitions. 11. Longitudinal profile and grade line. 12. Crest and sag vertical curves. 13. Coordination of horizontal and vertical alignment. 14. Cross-section and roadside. 15. Cross-sections, earthworks and preliminary drainage. 16. Embankments and cuttings. 17. Pavement options. 18. Surface drainage. 19. Bridge and culvert sites and road approaches. 20. At-grade intersections and junctions. 21. Roundabouts. 22. Introduction to grade separation and interchanges. 23. Pedestrian and cycle routes, public transport stops and roadside services. 24. Roadside safety and equipment. 25. Design in mountainous terrain. 26. Difficult ground and climatic conditions. 27. Reconstruction of existing roads. 28. Environmental and social impacts and life-cycle costs. 29. CAD, GIS and the information model. 30. Design quality checks and handover. **II. Instructions and recommendations for organizing laboratory exercises** The CAD/GIS laboratory sequence follows the laboratory guide. Each report records input data, operations, parameters, verification results and conclusions. A parametric corridor requires a road-design tool that links alignment, profile and template; a GIS line alone does not establish these relationships. Identify the source and accuracy of any supplied topographic dataset. Topics: 1. Import digital topographic data. Save a project recording units, horizontal and vertical reference systems and discrepancies at control points. 2. Create a digital terrain model and triangulated irregular network (TIN) surface. Check breaklines, boundaries and triangulation errors.

	3. Create a horizontal alignment and verify its geometry. Submit the tangent and curve elements, chainages and parameter schedule. 4. Create the ground profile and design profile. Check the ground and design lines, gradients and vertical curves. 5. Create a typical road cross-section. Submit a template defining carriageway, shoulder, crossfall, sideslope and ditch parameters. 6. Build a parametric corridor model. Link the alignment, profile and cross-section template and verify the corridor boundaries. 7. Generate cross-sections automatically and analyse them. Submit sections at check stations and verify consistency. 8. Compute earthwork volumes digitally. Submit the volume report, surface boundaries and a manually calculated check section. 9. Analyse flow paths and catchments in GIS. Map the catchments and drainage paths and state the terrain model's limitations. 10. Check sight distance and three-dimensional geometry digitally. Record deficiencies in relation to speed, observation points and obstructions. 11. Prepare plan, longitudinal profile and cross-section sheets. Use consistent scales, symbols and annotations throughout the drawing set. 12. Verify the model and exported files. Submit the project files, exchange format and check record, and defend the work individually. **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. Analyse the brief and input data. Submit a table identifying sources, requirements, units and missing information. 2. Forecast future traffic volumes. Submit calculations documenting the vehicle mix, analysis period and growth scenarios. 3. Estimate the design hourly flow and assess capacity. Record the basis for the road category and design parameters. 4. Calculate speed and stopping sight distance. Document the check, including assumptions for reaction, braking and longitudinal gradient. 5. Compare route corridors. Submit a selection matrix covering terrain, water, soils, land acquisition and safety. 6. Calculate route bearings, chainages and coordinates. Submit a checked schedule of intersection points and stations. 7. Calculate circular curve elements. Check that the radius, tangent length, arc length and chainages of the principal points agree with the drawing. 8. Prepare transition curve data. Provide the elements, connection points and an independent check calculation. 9. Calculate superelevation and widening. Show how crossfall changes along the transition, state its length and check drainage. 10. Check the horizontal alignment. Record curve consistency, chainages, sight distances and land-use constraints.

	11. Set the grade line on the longitudinal profile. Submit a table of gradients, control elevations and cut or fill depths. 12. Calculate a crest vertical curve. Submit a profile extract showing design elevations and the sight-distance check. 13. Calculate a sag vertical curve. Analyse the geometry, design elevations, headlight sight distance and water flow. 14. Develop alternative cross-sections. Draw sections in cut, on embankment and on sidehill terrain and dimension their elements. 15. Calculate earthwork quantities from cross-sections. Report areas, volumes and cut-and-fill balance, and show the preliminary drainage layout. 16. Select a cut-and-fill configuration for a sidehill site. Record ground and water conditions and the required stability checks. 17. Make a preliminary comparison of pavement options. Tabulate traffic loading, subgrade, climate, drainage and service-life assumptions. 18. Justify the catchment delineation and sideditch design. Submit a catchment plan, the assumed design discharge and a ditch-capacity check. 19. Assess a culvert location and its required discharge capacity. Document the inlet, outlet and elevations, and identify the data for detailed hydraulic analysis. 20. Check intersection geometry and sight triangles. Present the traffic movement diagram, turning-lane provision and geometric constraints. 21. Check the roundabout layout against the design vehicle envelope. Show the swept path and pedestrian connections on a drawing. 22. Select an interchange layout and preliminary ramp geometry. Tabulate alternatives against traffic demand and site constraints. 23. Coordinate pedestrian and cycle facilities with public transport stops. Draw continuous routes, crossings and accessible connections. 24. Prepare a roadside safety plan. Identify hazards, the proposed protective or risk-reduction measures, and the recorded checks. 25. Develop a mountain route alternative. Compare gradients, curves, geological hazards and earthwork quantities. 26. Incorporate difficult site constraints into the design. Prepare a schedule of technical measures addressing soil, irrigation, water and climate. 27. Justify traffic management stages during reconstruction. Show the existing road constraints and the sequence of construction. 28. Compare environmental impacts and life-cycle costs. Use a common analysis period and submit a table of discounting assumptions and sensitivity results. 29. Check quantities and model consistency. Record discrepancies between drawings, cross-sections and volumes and document the corrections. 30. Defend the integrated semester 6 design. Submit the alternatives, calculations, model, drawings and evidence of verification. **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. Use the design brief and applicable standards to tabulate the road category and design parameters. 2. Check traffic data, vehicle mix and growth scenarios in a small group, and compare the forecasts.

	3. Organise sources for terrain, soils, water and land constraints. Prepare an input data sheet. 4. Use worked examples to analyse design speed and the conditions under which different sight distances apply. 5. Compare route alternatives in a small group using length, earthworks, safety and land constraints. 6. Create a verifiable spreadsheet for horizontal curves, chainage, superelevation and widening. 7. Course design assignment: establish the brief and parameters, and develop the selected alignment plan, curve elements and chainages. 8. Course design assignment: calculate the longitudinal profile, vertical curves and cross-sections and prepare the drawings. 9. Complete the quantities, drainage layout, checking and defence for the course design assignment. 10. Justify the drainage layout and location of a highway structure in a small group. Identify the hydrological and geometric data needed for calculations. 11. Check the traffic movement diagram, geometry and vehicle envelope at a selected intersection. 12. Prepare a design and checklist for roadside, pedestrian, cyclist and public transport stop safety. 13. Compare engineering solutions for a mountain section or a site with difficult ground in a small group. Produce a hazard map. 14. Assess the interactions between earthworks, pavement structure and drainage. Tabulate materials and quantities of work. 15. Identify geometric constraints and develop stages for maintaining traffic during reconstruction of an existing road. 16. Compare two alternatives in a small group using environmental impacts, resources and life-cycle costs over the same period and with consistent assumptions. 17. Check digital model accuracy and agreement between calculations and drawings. Critically assess the approach used in a recent research paper. 18. Peer-review the final design package in a small group. Prepare a record of corrections, compile the results and prepare an individual defence.
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

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<tr><td></td><td>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>
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<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>Current assessment</td><td>30 points</td><td>System tasks</td><td>20 points (divided by</td><td>18 points</td></tr>
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<tr><td rowspan="2"></td><td rowspan="2"></td><td></td><td>number of tasks)</td><td rowspan="2"></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. SHNQ 2.05.02-23. Avtomobil yo‘llari. Loyihalash talablari [Highways. Design requirements]. Annex 1 to Order No. 01/2-61 of the Minister of Construction and Housing and Communal Services, 23 August 2024. www.lex.uz.
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9. UNSW Sydney. Official announcement of the QS World University Rankings 2027 results. June 2026. Rank reported in the syllabus: 19th. www.unsw.edu.au.

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