Name of subject	ADVANCED TECHNOLOGIES IN HIGHWAY DESIGN (ECTS 8)
Subject/module code	**AYLIT1103**
Science taught semester (s).	1st and 2nd semesters
Responsible teacher	Ganiyev Inomjon Gulomovich – head of the department "Road engineering", PhD, professor
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours – 240 hours** **Contact hours – 72 hours** Lecture training hours – 36 hours Practical training hours – 36 hours **Independent education – 168 hours**
ECTS	8
Course work	Yes - "Development of a variant highway design using GIS, BIM and AutoCAD Civil 3D".
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** To develop advanced knowledge and skills for highway design using modern digital technologies, GIS/GPS, BIM, AutoCAD Civil 3D, ArcGIS, data models and intelligent transport systems, with optimization of technical, economic, environmental and safety performance. **The objectives of teaching the subject** are to introduce emerging trends and digital concepts in road design; analyze topographic, geological, and traffic data within a geographic information system (GIS) environment; develop alternative road alignments using automated design methods; create models of roads, pavements, drainage systems, and civil engineering structures using Civil 3D and building information modelling (BIM) workflows; assess road safety, environmental impacts, and economic efficiency; analyze international practices, research articles, and relevant standards and regulations; and complete and defend a course project in accordance with scientific and technical requirements. **Learning outcomes:** 1. Explain the theoretical foundations and applications of advanced road-engineering technologies, GIS/GPS, BIM, digital terrain models and intelligent transport systems. 2. Collect, verify, systematize and analyze topographic, geological, hydrological and traffic data in a GIS environment. 3. Compare route alternatives using economic, environmental, topographic and safety criteria and justify an optimal alignment. 4. Develop horizontal and vertical alignment, profiles, cross-sections, subgrade and earthwork quantities in AutoCAD Civil 3D or equivalent software. 5. Create a 3D road information model in a BIM environment and generate material quantities, schedule and cost-estimate data. 6. Evaluate road-safety audit findings, environmental impacts, noise, air pollution, drainage and project economic efficiency. 7. Design pavement structures using modern calculation models, material properties and service-life criteria. 8. Integrate bridges, overpasses, culverts and other structures into the BIM model and place ITS elements in the project. 9. Analyze road-diagnostic results and propose innovative solutions for repair, reconstruction and operational management.

	10. Use scientific databases and official sources to prepare and defend technical reports, course work, drawings and presentations in accordance with academic-integrity requirements.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions).** Topics: 1. Introduction: advanced technologies in road engineering 2. Automated highway-alignment design 3. BIM technology in road infrastructure 4. Designing for road safety 5. Environmental criteria in highway design 6. Drainage and hydraulic structures in road design 7. Design for pavement durability 8. Economic efficiency of highway projects 9. IndorInfo/Road data model 10. Innovative pavement-design approaches 11. Advanced technologies for artificial structures 12. ITS and highway design 13. Management of road construction and operation 14. International practice analysis 15. Technical-economic project justification 16. Implementation analysis of advanced design technologies 17. Current research problems in the road sector 18. Analysis of complex and notable international highway projects **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. GIS/ArcGIS analysis of a selected area 2. Automated alignment design in AutoCAD Civil 3D 3. BIM modelling and quantity extraction 4. Road-safety and environmental calculations 5. Advanced pavement design 6. BIM modelling of bridges/overpasses/culverts 7. Integration of intelligent transport systems 8. Repair and reconstruction design using diagnostic data 9. Course-work defense **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. Review modern design standards and recent literature

	2. Analyze GIS/BIM/ITS resources of leading universities in small groups 3. Collect topographic, geological, hydrological and traffic data for course work 4. Develop alignment, profiles and earthworks in Civil 3D 5. Prepare a short scientific paper/report on a current road-engineering problem 6. Create a group BIM model of road, pavement and structures 7. Assess safety, environmental and economic indicators in a group 8. Finalize course work, drawings, technical-economic report and presentation
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. Ganiyev, I. Avtomobil yo‘llarini loyihalashning ilg‘or texnologiyalari / I. Ganiyev. — Jizzakh: So‘g‘diyona NMU, 2026. 134 b. 2. Rogers, M. Highway Engineering / M. Rogers, B. Enright. — 4th ed. — Wiley-Blackwell, 2023. — 448 p. 3. Goswami, S. Computer-Aided Highway Engineering / S. Goswami, P. Sarkar. — 1st ed. — CRC Press, 2021. — 518 p. 4. Delafield, R. W. AutoCAD Civil 3D 2024 for Engineers / R. W. Delafield. — SDC Publications, 2023. 5. BIM Teaching and Learning Handbook: Implementation for Students and Educators / ed. by M. R. Hosseini, F. Khosrowshahi, A. Aibinu, S. Abrishami. — 1st ed. — Routledge, 2022. — 370 p. 6. FHWA. Building Information Modeling (BIM) Practices in Highway Infrastructure: FHWA Global Benchmarking Program Report: Awareness, Leadership, Preparation, and Collaboration Around BIM : fact sheet. — FHWA, 2022. — 4 p. — Publication No. FHWA-HRT-22-049.