Name of subject	**GEOINFORMATION TECHNOLOGIES FOR ROADS AND AERODROMES (ECTS 6)**
Subject/module code	**YKILRQ2010**
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	Elective
Training hours (this including independent education)	**Total hours – 180 hours** **Contact hours – 54 hours** Lecture training hours – 24 hours Practical training hours – 30 hours **Independent education – 126 hours**
Course work	No
ECTS	6
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** to develop master's students' competence in using geospatial data to address the design, construction, operation and asset management of roads and aerodromes. **The objectives of teaching the subject** are – to explain coordinate systems and geospatial data models; integrate GNSS data, survey measurements and imagery; inventory road and aerodrome assets; analyze terrain, drainage, networks and spatial constraints; assess maintenance priorities based on condition and risk; and teach students to present findings through maps, databases and engineering reports. **Learning outcomes:** 1. Explain the role of GIS in transport infrastructure and the scope and limitations of vector and raster models. 2. Justify the choice of coordinate system and projection; identify errors in layer reprojection. 3. Assess data accuracy, completeness and currency, and explain the limitations of engineering conclusions. 4. Validate GNSS points, attributes, orthophotos and open geospatial data, and integrate them into a single GIS project. 5. Create a geospatial database with identifiers for road, bridge, culvert or aerodrome components. 6. Use a DEM to analyze slopes, longitudinal profiles and flow directions, and verify the results. 7. Apply buffering, overlay analysis and network methods to an engineering problem. 8. Justify maintenance priorities using condition, transport importance and risk indicators. 9. Prepare a mobile data collection form and an interactive map; define metadata and update procedures. 10. Submit a GIS project with files that enable reproduction, a map and a report, and defend the decisions made.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions).** Topics: 1. GIS and transport infrastructure 2. Coordinate systems and map projections 3. Geospatial data models and quality 4. Geospatial data collection 5. Remote sensing and orthophotography

	6. Digital terrain models 7. Road corridors and spatial constraints 8. Road asset management in GIS 9. Aerodrome geospatial data 10. Spatial and multicriteria analysis 11. Transport network analysis 12. Web GIS and presentation of results **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. Create a QGIS project. 2. Select a coordinate system and reproject layers. 3. Create road segment and asset layers. 4. Import and clean GNSS/CSV data. 5. Georeference a raster or orthophoto. 6. Derive elevation and slope maps from a DEM. 7. Generate a road longitudinal profile. 8. Analyse flow directions and drainage conditions. 9. Buffer a road corridor and intersect it with constraint layers. 10. Inventory bridges and culverts in GIS. 11. Map aerodrome components. 12. Create a thematic pavement condition map by segment. 13. Calculate multicriteria maintenance priorities. 14. Find routes in a network. 15. Present and defend an interactive map and the final GIS project. **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. Define the objectives, scope and data plan for a GIS project for a selected road or aerodrome. 2. Compare distances and areas in two coordinate systems; explain the causes of discrepancies in a brief report. 3. Jointly develop a road asset database schema, identifiers and an attribute dictionary. 4. Compare open-source vector and raster datasets by quality, scale and update date. 5. Identify coordinate and attribute errors in GNSS or CSV points and prepare a data cleaning log.

	6. Georeference an orthophoto; check control point errors as a group and defend the results. 7. Evaluate a DEM source, produce a slope map and explain its limitations for engineering use. 8. Prepare a longitudinal profile and drainage analysis for a selected road section. 9. Compare two road corridors against spatial constraints and defend the preferred option as a group. 10. Prepare a digital asset record for a bridge or culvert, including attributes, inspection date and photographs. 11. Develop metadata documentation and a topology checklist; retain a history of error corrections. 12. Peer-review the Semester 1 GIS database and map; defend the group results and each member's contribution. 13. Prepare a model of training layers for aerodrome components and a data update procedure. 14. Map pavement condition by segment and justify the classification criterion. 15. Define maintenance priority criteria and weights as a group; assess sensitivity to changes in weights. 16. Analyse two routes by distance, time and constraints, and explain the decision. 17. Critically review one scholarly source on GIS and road asset management published within the last five years. 18. Jointly prepare the final GIS project, interactive map and engineering report; defend each member's contribution.
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,	10 points	

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<tr><td></td><td></td><td>practical, laboratory classes)</td><td></td><td></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. Tang, T. Fundamentals of Geographic Information Systems (GIS) Analysis: Applying ArcGIS Pro. John Wiley & Sons, 2025. ISBN 9781394252169. DOI: 10.1002/9781394252190.
2. Law, M.; Collins, A. Getting to Know ArcGIS Pro 3.2. Esri Press, 2024. 352 p. ISBN 9781589487772.
3. QGIS Project. QGIS User Guide. Version 3.44. Online guide. https://docs.qgis.org/3.44/en/docs/user_manual/index.html
4. QGIS Project. QGIS Training Manual. Version 3.44. Online training manual. https://docs.qgis.org/3.44/en/docs/training_manual/
5. Open Geospatial Consortium. OGC GeoPackage Encoding Standard. Version 1.4.0. OGC 12-128r19. 2024. https://www.geopackage.org/spec140/
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