Course title	**Computer Technologies in the Design of Building Structures (ECTS 4)**
Course/module code	QKLKT2710
Semesters in which the course is taught	Semester 9/10
Assigned lecturer	Djurayev Uktam Uralboyevich, Associate Professor
Language of instruction	Uzbek
Course type	Compulsory
Study hours (including independent study)	**Total hours – 240** **Classroom hours – 36** Lecture hours – 8 Laboratory hours – none Practical class hours – 8 **Independent study – 104 hours**
ECTS	4
Course aims and objectives / learning outcomes	**The aim of the course is to introduce future civil engineers to the computer software used in the analysis and design of buildings and structures, and to teach them to make effective use of modern methods in selecting cross-sections for structural members and designing them.** **Course objectives: students should study modern analysis methods, know how to build a computer model of the design process and acquire the skills to solve it; be able to solve their own problems using standard software; be able to solve engineering and economic problems with modern application software; and master methods for the effective use of computer technologies in solving professional problems.**
Course content (topics)	**I. Main theoretical part (Lectures)** Topic 1: Aims and objectives of the analysis and design of building structures. Definition and overview of the software used in design and construction. The ribbon interface of the LIRA-SAPR® 2017 software package. The "Toolbar". Modelling the plane frame of a two-span, two-storey building. Topic 2: Assigning supports (restraints) and hinges. Applying loads. Analysis and design of reinforced concrete cross-sections in the LIR-ARM system. Generating tables of analysis results. Topic 3: Slab analysis. Creating the geometric model of an industrial building frame. Topic 4: Creating the geometric model of the spatial frame of a building on a slab (raft) foundation resting on an elastic subgrade. The architectural design, form-making and analysis system (SAPFIR 3D). Tools of the SAPFIR 3D system. Topic 5: Setting up the problem of analysing a multi-storey building with a beamless (flat-slab) frame and designing a cast-in-situ reinforced concrete slab using the SAPFIR-KONSTRUKSIYA and SAPFIR-JBK systems. Creating and editing floor slabs. Topic 6: Modelling a ramp. Topic 7: Creating load cases and applying loads. Opening the analysis model in the LIRA-SAPR software package. Running the analysis model in LIRA-SAPR and analysing the results. Topic 8: Additional reinforcement of a cast-in-situ reinforced concrete floor slab using the SAPFIR-JBK system. Additional reinforcement of a reinforced concrete slab using the SAPFIR-JBK system. Creating the geometric model for detailing cast-in-situ columns and beams using the SAPFIR-JBK system. Editing the automatic detailing of beams and creating a drawing sheet for a beam. Topic 9: Setting up the design of a reinforced concrete shear wall (diaphragm) in SAPFIR-JBK. Automatically rearranging the layout of

shear wall drawings and working with the shear wall section. Arranging auxiliary zones and dimensioning reinforced joints. Generating shear wall drawings automatically.

II. Guidelines and recommendations for organising laboratory classes

Laboratory classes are not included in the curriculum.

III. Guidelines and recommendations for practical classes

The lecturer's preparation for a practical class begins with studying the source documents (curriculum, thematic plan, etc.) and ends with drawing up a lesson plan. The lecturer must have a clear idea of the aims and objectives of the practical class and of the amount of work each student is to complete.

Methodological guidelines are the lecturer's main methodological document for preparing and conducting practical classes.

The aim of practical classes is to understand the theory and acquire skills: to develop the ability to apply it consciously in academic and professional activity and to form one's own point of view convincingly.

Recommended practical topics:

1. Analysis of a single-span, single-storey frame. Modelling the plane frame of a two-span, two-storey building. Analysis of a flat slab.
2. Creating the geometric model of an industrial building frame. Assigning stiffness properties to its members. Applying loads to the industrial building frame.
3. Creating the geometric model of the spatial frame of a building on a slab (raft) foundation resting on an elastic subgrade.
4. Creating the geometric model of a steel tower. Assigning stiffness properties to the tower members. Static analysis of the steel tower and calculation of the loads transferred to the foundation. Creating the geometric model of a cylindrical tank. Static analysis of the cylindrical tank and analysis of the results.
5. Setting up the problem of analysing a multi-storey building with a beamless (flat-slab) frame and designing a cast-in-situ reinforced concrete slab using the SAPFIR-KONSTRUKSIYA and SAPFIR-JBK systems. Creating and editing floor slabs. Modelling a ramp. Creating load cases and applying loads.
6. Opening the analysis model in LIRA-SAPR. Designing a cast-in-situ reinforced concrete floor slab using the SAPFIR-JBK system. Additional reinforcement of a reinforced concrete slab using SAPFIR-JBK. Creating the geometric model for detailing cast-in-situ columns and beams using SAPFIR-JBK. Creating a marking section of vertical members. Creating a drawing sheet with marking plans and sections.
7. Detailing a cast-in-situ reinforced concrete column. Correcting the automatic detailing of beams. Creating a drawing sheet for a beam. Setting up the design of a reinforced concrete shear wall in SAPFIR-JBK. Automatically rearranging the layout of shear wall drawings.
8. Creating an opening in a group of unified shear walls. Adjusting the reinforcement zone spacing to the module. Fitting reinforcement around window openings. Working with the shear wall section. Arranging auxiliary zones. Dimensioning reinforced joints. Generating shear wall drawings automatically.
9. Creating the geometry of a structure on a soil foundation using the YANGI GRUNT (New Soil) system. Assigning boundary conditions to the frame. Assigning stiffness properties to the frame members. Defining elastic subgrade parameters. Applying loads. Static analysis of the frame. Viewing and analysing the results.

IV. Independent study and independent work

The independent study competence helps students develop themselves independently and serves to increase the effectiveness of their professional activity. Students complete independent work under the lecturer's supervision, either in traditional form or electronically on their mobile devices.

Recommended topics for independent study:

1. Aims and objectives of the analysis and design of building structures.
2. Definition and overview of the software used in design and construction.
3. The ribbon interface of the LIRA-SAPR® 2017 software package.
4. Modelling the plane frame of a two-span, two-storey building.
5. Assigning supports (restraints) and hinges.
6. Applying loads.
7. Analysis and design of reinforced concrete cross-sections in the LIR-ARM system.
8. Generating tables of analysis results.
9. Slab analysis.
10. Creating the geometric model of an industrial building frame.
11. Assigning stiffness properties to the members of an industrial building frame.
12. Applying loads to an industrial building frame.
13. Static analysis of the frame. Stability analysis of the frame.
14. Creating the geometric model of the spatial frame of a building on a slab (raft) foundation resting on an elastic subgrade.
15. Assigning stiffness to the members of a spatial frame.
16. Static analysis of a spatial frame and analysis of the results.
17. Setting up the analysis problem for a steel tower.
18. Creating the geometric model of a steel tower.
19. Assigning stiffness properties to the members of a steel tower.
20. Static analysis of a steel tower and calculation of the loads transferred to the foundation.
21. Creating the geometric model of a cylindrical tank.
22. Static analysis of a cylindrical tank and analysis of the results.
23. Setting up the problem of analysing a multi-storey building with a beamless (flat-slab) frame and designing a cast-in-situ reinforced concrete slab using the SAPFIR-KONSTRUKSIYA and SAPFIR-JBK systems.
24. Creating and editing floor slabs.
25. Modelling a ramp.
26. Creating load cases and applying loads.
27. Opening the analysis model in the LIRA-SAPR software package.
28. Designing a cast-in-situ reinforced concrete floor slab using the SAPFIR-JBK system.
29. Creating a drawing sheet with marking plans and sections. Detailing a cast-in-situ reinforced concrete column.
30. Correcting the automatic detailing of beams. Creating a drawing sheet for a beam.
31. Setting up the design of a reinforced concrete shear wall in SAPFIR-JBK. Automatically rearranging the layout of shear wall drawings.
32. Creating an opening in a group of unified shear walls. Adjusting the reinforcement zone spacing to the module.
33. Fitting reinforcement around window openings. Working with the shear wall section.
34. Arranging auxiliary zones.
35. Dimensioning reinforced joints.
36. Generating shear wall drawings automatically.

V. Course work (CW)

	1. "Analysis and detailing of the reinforced concrete frame of a multi-storey building" using the SAPFIR 2017 R3 and LIRA-SAPR 2017 R3 software packages **2. "Analysis and detailing of a multi-storey building with a beamless (flat-slab) frame" using the SAPFIR 2017 R3 and LIRA-SAPR 2017 R3 software packages** **3. "Analysis and detailing of the frame of an industrial building" using the SAPFIR 2017 R3 and LIRA-SAPR 2017 R3 software packages**
Student assessment	Assessment of students' knowledge during the semester and the final examination is based on their mastery of the course material (results of tests, assignments, and written and oral work). Throughout the course "Assessment of the Technical Condition of Buildings and Structures", students are assessed on a 100-point scale. Of these, 50 points are allocated to continuous and midterm assessment (60% of the 50 points for continuous assessment and independent study, 40% for midterm assessment), and 50 points to the final examination. Students whose combined continuous and midterm score is below 30 points are not admitted to the final examination. A student who scores 30 or more points in the final examination is considered to have passed the course.
Examination requirements	The student must have fully mastered the theoretical and practical concepts of the topic and be able to present the results of the analysis correctly. The student must have completed the independent work and the assignments set in continuous and midterm assessment. In addition, the student must have obtained the required points in continuous, midterm, independent study and final assessment for the course within the set time. A student who has not submitted the continuous assessment, midterm assessment and independent study assignments, or who has scored fewer than 30 points for these assignments and forms of assessment, is not admitted to the final examination. Furthermore, a student who misses 25% or more of the classroom hours allocated to the course without a valid reason is withdrawn from the course, is not admitted to the final examination, and is considered not to have earned the credits for the course. A student who fails the final examination or scores between 0 and 29.9 points in it is considered to have an academic debt.
Recommended literature	*1. Djurayev U.U. Computer Technologies in the Design of Building Structures [Qurilish konstruksiyalarini loyihalashda kompyuter texnologiyalari]. Textbook. Jizzakh, 2023. 246 p.* *2. Matkarimov S.Yu. Computer Technologies in the Design of Building Structures [Qurilish konstruksiyalarini loyihalashda kompyuter texnologiyalari]. Textbook. Tashkent, 2020.* *3. Matkarimov S.Yu., Nizomov Sh.R. Analysis and Automation of Building Structures Based on Computer Programs [Kompyuter dasturlari asosida qurilish konstruksiyalarini hisoblash va avtomatlashtirish]. Tashkent, 2013.* *4. Yusupkhodjayev S.A. Building Structures [Qurilish konstruksiyalari]. Textbook. Tashkent: National Society of Philosophers of Uzbekistan, 2019. 376 p.* *5. Lebed E.V. Computer Technologies in the Design of Spatial Steel Building Frames [Kompyuternye tekhnologii v proektirovanii prostranstvennykh metallicheskikh karkasov zdaniy]. Moscow: MGSU, 2017. 141 p.*

	6. Mirziyoyev Sh.M. Ensuring the Rule of Law and Human Interests Is the Guarantee of the Country's Development and the People's Well-being [Qonun ustuvorligi va inson manfaatlarini ta'minlash – yurt taraqqiyoti va xalq farovonligining garovi]. Tashkent: Uzbekistan, 2016. 47 p. 7. KMK 2.01.03-19. Construction in Seismic Areas [Seysmik hududlarda qurilish]. Ministry of Construction of the Republic of Uzbekistan. Tashkent, 2019. *8. www.mc.uz*www.mc.uz *9. https://gov.uz/oz/mc/sections/shaharsozlik-normalari-qurilish-va-texnik-reglamentlar*https://gov.uz/oz/mc/sections/shaharsozlik-normalari-qurilish-va-texnik-reglamentlar *10. www.ZiyoNet.uz*www.ZiyoNet.uz 11. www.twirpx.comwww.twirpx.com