Course title	Fundamentals of Designing Building Structures in Accordance with European Union Standards (Eurocodes) (ECTS 10)
Subject/module code	YeIMQKLA1110
Semesters in which the course is taught	Semesters 1/2
Assigned instructor	R. Khamraqulov, Associate Professor, Candidate of Technical Sciences
Language of instruction	Uzbek
Course type	Compulsory
Study hours (including independent study)	**Total hours – 300.** **Classroom hours – 90.** Lecture hours – 44 Practical class hours – 46 **Independent study – 210 hours**
ECTS	10
Aim and objectives of the course / learning outcomes	**Aim of the course:** to develop in future civil engineers theoretical and practical knowledge of designing and calculating residential buildings and structures according to European Union standards (Eurocodes), and of their structural elements. **Objectives of the course:** to teach students how to use building structures in the construction of buildings in accordance with European Union standards, and to find technically efficient solutions for construction practice in the construction of buildings and structures. **Learning outcomes:** *Professional competencies:* 1. Thoroughly master the theoretical foundations of the subject and be able to use calculation formulas and modern calculation methods in solving practical problems; 2. Correctly select the design scheme of building structures according to European Union standards (Eurocodes) and develop the basic skills of calculating them under seismic action; 3. Be able to analyse the stresses and deformations determined as a result of calculations and have sufficient competence in ensuring the earthquake resistance of buildings and structures. *Skills:* 4. Analyse results obtained under two sets of standards and justify the design solution; 5. Prepare a calculation (design) report in accordance with the Eurocode;
Course content (topics)	**I. Main theoretical part (Lectures) – 44 hours in total** ***Semester 1 (26 hours)*** **Topic 1:** Procedure for calculating and designing building structures according to European Union standards (Eurocodes). Aims and objectives of calculating and designing building structures. Stages of calculating and designing building structures. **Topic 2:** Calculation of building structures according to European Union standards (Eurocodes) using the finite element method. Reinforced concrete structures. Limit state design. The essence of the limit state method. Checking the crack resistance of reinforced concrete structures. **Topic 3:** Loads and actions. Types of loads acting on building structures. Permanent loads. Variable (temporary) loads. Characteristic (standard) loads. Load combinations. **Topic 4:** Properties of concrete. Strength of concrete. Deformation of concrete. Concrete classes. Characteristic and design values of concrete. **Topic 5:** Properties of reinforcement. Types of reinforcement according to their function in reinforced concrete structures. Range of strengthening. Physical and mechanical properties of reinforcement.

	Methods of strengthening. **Topic 6:** Characteristic and design resistance of concrete and reinforcement according to European Union standards (Eurocodes). Strength and deformation properties of concrete. Strength and deformation properties of steel reinforcement. **Topic 7:** Stages of the stress-strain state of reinforced concrete structures. The first stage of the stress-strain state of reinforced concrete structures. The second stage of the stress-strain state of reinforced concrete structures. The third stage of the stress-strain state of reinforced concrete structures. **Topic 8:** Specific features of designing reinforced concrete elements according to European Union standards (Eurocodes). General information on slabs and their design. General information on beams and their standards. **Topic 9:** Fundamentals of calculating the strength of flexural elements in regular sections according to European Union standards (Eurocodes). Singly reinforced rectangular sections. Calculation of rectangular sections using tables. Calculation of sections with T-shaped profiles. Calculation of doubly reinforced sections. Determining the reinforcement ratio. **Topic 10:** Fundamentals of calculating the strength of reinforced concrete elements working in bending according to European Union standards (Eurocodes). Effect of shear forces on non-rectangular sections. Effect of moments on non-rectangular sections. Reinforcement. **Topic 11:** Specific features of designing compression reinforced concrete elements according to European Union standards (Eurocodes). General information on compression elements. Design and reinforcement of compression elements. Taking into account the bending (buckling) of an element. Calculation of elements with accidental eccentricity. **Topic 12:** Fundamentals of calculating and designing prestressed reinforced concrete elements. Theory of prestressed concrete. Specific features of prestressed concrete structures. Properties of materials. **Topic 13:** Basic requirements for designing prestressed reinforced concrete structures. Factors causing loss of prestress and their analysis. Basic and additional requirements. Calculation of prestressed reinforced concrete structures for the first and second groups of limit states. ***Semester 2 (18 hours)*** **Topic 14:** Basic and additional requirements for calculating prestressed reinforced concrete structures. Calculation based on load-bearing capacity. Calculation based on serviceability. Calculation of structural integrity. **Topic 15:** Prestressed reinforced concrete structures for the construction of industrial buildings. Prestressed reinforced concrete floor structures. Prestressed reinforced concrete beam structures. Prestressed reinforced concrete roof structures. **Topic 16:** Procedure for calculating and designing building structures according to European Union standards (Eurocodes). Aims and objectives of calculating and designing building structures. Stages of calculating and designing building structures. Composition of the building structure standards. **Topic 17:** Limit state calculation of building structures according to European Union standards (Eurocodes). Calculation according to the first group of limit states. Calculation according to the second group of limit states. **Topic 18:** Calculating the crack resistance of building structures according to European Union standards (Eurocodes). Stress-strain state of reinforced concrete structures. Stress-strain diagram. **Topic 19:** Characteristic and design values of concrete. Strength of concrete. Deformation of concrete. Concrete classes. Design and

	characteristic values of concrete.. **Topic 20:** Types of reinforcement according to the function performed by reinforced concrete structures. Types of reinforcement according to their function in reinforced concrete structures. Range of strengthening. Physical and mechanical properties of reinforcement. Methods of strengthening. **Topic 21:** Characteristic and design resistance of reinforced concrete according to European Union standards (Eurocodes). Strength and deformation properties of reinforced concrete. Strength and deformation properties of steel reinforcement. **Topic 22:** The influence of the shrinkage and creep of concrete on the deformation of reinforced concrete structures. Shrinkage and creep deformations in reinforced concrete elements. Changes in the dimensions and shape of structures over time due to the shrinkage and creep of concrete, without an increase in external load. **II. Practical class topics (2 hours each) – 46 hours in total** ***Semester 1 (28 hours)*** 1. Physical and mechanical properties of concrete. Strength and deformation properties of heavy and lightweight concrete. 2. Physical and mechanical properties of reinforcement. Properties of reinforcement for ordinary and prestressed reinforced concrete structures. 3. Scientific and experimental foundations of the stress-strain states of reinforced concrete. 4. Basic requirements for designing reinforced concrete structures. 5. Calculating the strength of reinforced concrete elements in the normal section (singly reinforced). 6. Calculating the strength of reinforced concrete elements in the normal section (doubly reinforced). 7. Calculating the strength of reinforced concrete elements in the normal section. T-shaped sections. 8. Methods of calculating reinforced concrete structures according to European Union standards (Eurocodes). Limit state calculation. Loads and actions.. 9. Checking the overall stability of load-bearing structures. 10. Calculating a multi-span frame for limit states. 11. Determining the design forces acting on a multi-span frame. 12. Requirements for designing reinforced concrete elements. 13. Requirements for designing prestressed reinforced concrete elements. 14. Research carried out to determine the properties of concrete and reinforcement in reinforced concrete structures according to European Union standards (Eurocodes). ***Semester 2 (18 hours)*** 15. Research carried out to assess the quality of reinforced concrete structures according to European Union standards (Eurocodes). 16. Mechanical properties of special concretes. Strength and deformation properties of heavy concrete and fibre-reinforced concrete. 17. Mechanical properties of high-quality reinforcement. Reinforcement for ordinary and prestressed reinforced concrete structures. 18. Calculation of reinforced concrete beams, scientific and experimental foundations of stress-strain states. 19. Requirements for designing reinforced concrete structures working in bending. 20. Calculating the strength of flexural elements (singly reinforced) in the inclined section. Calculating the strength of flexural elements (doubly reinforced) in the inclined section. 21. Calculating the strength of flexural elements in the inclined

	section. 22. T-shaped sections. 23. Limit state calculation. **III. Independent study and independent work – 210 hours in total** ***Semester 1 (126 hours)*** 1. Working mechanism of concrete under load according to European Union standards (Eurocodes). (6 hours) 2. Specific features of lightweight concrete. (6 hours) 3. The "stress-strain" states of concrete and reinforcement. (6 hours) 4. Strength classes of concrete and their determination. (6 hours) 5. Types of concrete and reinforced concrete structures and determining their "stress-strain" states. (6 hours) 6. Calculating building structures according to the first group of limit states. (6 hours) 7. Characteristic and design loads, load combinations (their combined action). Material reliability factor. (6 hours) 8. Calculating structures according to the second group of limit states. (6 hours) 9. History of concrete and reinforced concrete structures. (6 hours) 10. Calculating the strength of flexural elements (singly reinforced) according to SHNQ 1.03.03-23 and "Eurocode 2". (6 hours) 11. Calculating the strength of flexural elements (doubly reinforced) according to SHNQ 1.03.03-23 and "Eurocode 2". (6 hours) 12. Design of prestressed reinforced concrete structures. (6 hours) 13. Determining the reinforcement of prestressed reinforced concrete structures. (6 hours) 14. Structures of industrial buildings and the requirements placed on them. Main load-bearing elements in single-storey industrial buildings and their structural scheme. (6 hours) 15. Roof structures of industrial buildings. Main structural elements and schemes. (6 hours) 16. Researching the behaviour of heavy concrete under load. (6 hours) 17. Specific features of lightweight concrete. (6 hours) 18. "Stress-strain" states in reinforced concrete structures. (6 hours) 19. Research work on increasing the strength of concrete. (6 hours) 20. Types of high-strength concrete and their use in structures. (6 hours) 21. Advantages of limit state calculation of building structures. (6 hours) ***Semester 2 (84 hours)*** 22. Reliability factor of concrete. Reliability factor according to the function of the building. (8 hours) 23. Constructing the material (bending moment) envelope diagrams when calculating monolithic reinforced concrete structures. (8 hours) 24. Reinforcement cages used in reinforced concrete structures. (8 hours) 25. Calculating the strength of flexural elements according to "Eurocode 2" and selecting the cross-sectional area of the working reinforcement. (10 hours) 26. Calculating the strength of elements according to "Eurocode 2". T-shaped sections. Selecting the cross-sectional area of the working reinforcement. (10 hours) 27. Researching concretes in prestressed reinforced concrete structures. (10 hours) 28. Researching high-strength reinforcement, strands and wires in prestressed reinforced concrete structures. (10 hours) 29. Structures of industrial buildings and the requirements placed on them. Main load-bearing structures in single-storey industrial buildings

	and their structural scheme. (10 hours) 30. Designing structures of industrial buildings according to European Union standards (Eurocodes). Main structural elements and schemes. (10 hours)
Assessment of students	Assessment of students' knowledge is based on indicators of mastery of the teaching materials (results of tests, assignments, and written and oral work) during the semester and final control. During the Eurocodes course, students are assessed on a 100-point scale. Of this, 50 points are allocated to the results of current and midterm assessment (of the 50 points, 60% is for current control and independent study and 40% for midterm control), and 50 points to the result of final control. Students whose total result of current and midterm scores is below 30 points are not admitted to the final control exam. A student who scores 30 points or more in the final control is considered to have mastered the course. **Assessment criteria:** **a) To receive a grade of 5, the student's level of knowledge must meet the following:** – can fully explain the essence and content of the subject; – maintains scientific rigour and logic when presenting the topics of the subject, and avoids scientific errors and confusion; – has a clear understanding of the theoretical or practical significance of the subject materials; – can demonstrate the ability to think independently and freely within the subject; – can give clear and concise answers to the questions asked; – has prepared lecture notes thoroughly; – has completed independent assignments fully and accurately; – has mastered all practical skills and competencies; – is able to apply theoretical knowledge in various situations; – takes a systematic approach and follows continuity. **b) To receive a grade of 4, the student's level of knowledge must meet the following:** – has understood the essence and content of the subject and avoids scientific and logical confusion when presenting the topics of the subject; – has understood the practical significance of the content of the subject; – performs the tasks and assignments given in the subject within the scope of the curriculum; – can give correct answers to the questions asked on the subject; – has compiled thorough lecture notes on the subject; – has fully completed the independent assignments on the subject; – has tried to master all practical skills and competencies. **c) To receive a grade of 3, the student's level of knowledge must meet the following:** – has a general understanding of the subject; – covers the topics of the subject within a narrow scope and makes some confusions in presenting them; – has fully completed the independent assignments on the subject; – the presentation is not fluent; – gives vague and confused answers to questions on the subject; – the text on the subject has not been thoroughly prepared. **d) In the following cases, a student's level of knowledge may be assessed as unsatisfactory, with a grade of 2:** – has not prepared for classes in the subject; – has no idea whatsoever about the classes in the subject; – has not fully completed the independent assignments on the subject; – it is evident that the texts on the subject were copied from others;

	– serious errors and confusion are made in the text on the subject; – no answer is obtained to the questions on the subject; – does not know the subject.
Requirements for examinations	Fully mastering the theoretical and methodological concepts of the subject, being able to correctly reflect the results of analysis, reasoning independently about the processes under study, completing the tasks and assignments given in the forms of current and midterm control, and submitting the control assignment for final control. The student must have fully mastered the theoretical and practical concepts on the topic and be able to correctly reflect the results of analysis. The student must have completed the assignments given in independent work and in the current and midterm forms of assessment. In addition, within the established time, the student must have obtained sufficient points in the current, midterm, independent study and final controls of the relevant subject. A student who has not submitted the current control, midterm control and independent study assignments, and who has scored fewer than 30 points in these assignments and types of control, is not admitted to the final control. Likewise, a student who has missed 25% or more of the classroom hours allocated to the subject without a valid reason is excluded from the subject, is not admitted to the final exam, and is considered not to have earned the corresponding credits in the subject. A student who fails the final exam or who scores in the range of "0–29.9" points in this type of exam is considered to have an academic debt.
Recommended literature	**Main literature** 1. Artur Nilson, David Darwin, Charles Dola. Design of Concrete Structures 14th Edition. USA 2018. 2. S.A.Yusupxodjayev "Qurilish konstruksiyalari" Darslik. Toshkent. "O'zbekiston faylasuvlari milliy jamiyati". 2019 376. 3. U.U.Djurayev "Temirbeton va tosh konstruksiyalari" Darslik Jizzax 2022-yil **Additional literature** 4. B.A.Asqarov Sh.R.Nizomov Temirbeton va tosh- g'isht qurilishlari. Darslik. Toshkent. 2008. **Information sources** 5. www.ziyonet.uz 6. https://www.liraland.ru/video/lira/ 7. http://www.setkov-psk.perm.ru/p15.htm 8. https://www.facebook.com/groups/lirasaprtraining/