Course title	Special Reinforced Concrete Structures (ECTS 6)
Subject/module code	MTK1106
Semesters in which the course is taught	Semester 1
Assigned instructor	R. Khamraqulov, Associate Professor, Candidate of Technical Sciences
Language of instruction	Uzbek
Course type	Compulsory
Study hours (including independent study)	**Total hours – 180.** **Classroom hours – 54.** Lecture hours – 26 Practical class hours – 28 **Independent study – 126 hours**
ECTS	6
Aim and objectives of the course / learning outcomes	**Aim of the course:** to develop in students, in line with their professional profile, the knowledge, skills and competencies in the fundamentals of designing and calculating civil buildings and structures operating under complex conditions, and their structural elements. **Objectives of the course:** to teach students methods of designing and calculating buildings under a complex stress-strain state, the use of building and structure designs in construction, and the search for economically efficient solutions for reinforced concrete structures of buildings and structures in construction practice. **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 dynamic design scheme of special reinforced concrete structures 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. The types, purpose and operating characteristics of special steel structures; 5. Steel grades, and methods of corrosion and fire protection. 6. Determining the loads acting on a structure and compiling their combinations; calculating the main elements of towers, tanks, bunkers and spatial roofs; calculating welded and bolted connections and detailing joints; calculating crane runway beams and elements of an industrial frame.
Course content (topics)	**I. Main theoretical part (Lectures)** **Topic 1:** General information on special reinforced concrete structures. Design and verification of the ultimate strength and serviceability of reinforced concrete structures. Types of reinforced concrete structures according to their volumetric-planning solution. Kinds of architectural and structural forms. Classification of spatial structures. Information on curved surfaces. Methods of translation and rotation. Classification of the geometric theory of surfaces. **Topic 2:** General information on thin-walled reinforced concrete structures and the principles of their design. The place of thin-walled reinforced concrete structures in construction. Advantages of thin-walled reinforced concrete roofs. Shortcomings of thin-walled reinforced concrete structures. Fields of application of thin-walled structures. **Topic 3:** General information on cylindrical shells. Types of

	cylindrical shells according to their dimensions. Cast-in-place and precast cylindrical shells. Loading stages of cylindrical shells. **Topic 4:** Fundamentals of designing long cylindrical shells. Components of long cylindrical shells. Methods of calculating cylindrical shells. Calculation of a long cylindrical shell with a circular profile. Reinforcement of cylindrical shells. **Topic 5:** Fundamentals of designing short cylindrical shells. Prestressing of spatial roof structures. Design of thin-walled spatial structures and selection of reinforcement. **Topic 6:** General information on domes and domed shells. Folded structures (folded plates) and the components of shells. Prismatic folded plates. Calculation and reinforcement of prismatic folded plates. Basic forms of vaults (cupolas). Schemes for taking up the thrust of cupolas mounted on columns. **Topic 7:** Fundamentals of designing shells with positive and negative Gaussian curvature. Precast shells of positive Gaussian curvature for rectangular plans. Diagrams of internal forces and moments in shells of double curvature with a square plan. Reinforcement of a hollow (cellular) shell of double curvature with a rectangular plan. **Topic 8:** The finite element method for calculating composite shells. Shells of negative Gaussian curvature (hypars). Shells with a surface of negative Gaussian curvature and a rectangular plan. **Topic 9:** General information on the structural schemes of shells. History of dome structures. Types of dome structures according to their structural scheme. Connection of dome panels with the support and the upper ring. Domes composed of large-size cylindrical panels. Domes composed of flat panels. **Topic 10:** Fundamentals of calculating dome shells. Structural solution of domes. Conditions for the membrane (momentless) behaviour of a dome shell. Stress-strain state of the shell. Determining meridional and tangential bending moments in the shell. **Topic 11:** Types of reservoirs and their elements. Characterization of the properties of concrete and steel affecting changes in the structure of reinforced concrete structures under service and extreme conditions. Types of tanks. Load-bearing structures of tanks. Roof structures of tanks. Determining the loads acting on tanks. Calculating loads from liquids and bulk materials. Strength calculation of tanks. **Topic 12:** Bunkers. Fundamentals of calculation. **Topic 13:** Silos. Fundamentals of calculation. **II. Practical class topics (2 hours each)** 1. Physical and mechanical properties of materials used in special reinforced concrete structures. 2. Calculation of spherical domes. 3. Calculation of conical domes. 4. Calculation of tall domes. 5. Calculation of elliptical domes. 6. Determining the bending moments in the dome support ring. Calculation of dome elements. 7. Calculation of a monolithic reinforced concrete dome. 8. Calculation of a precast-monolithic reinforced concrete dome with meridional ribs. 9. Determining the permissible ultimate load value of a spherical shell. 10. Calculation and design of tanks. General information on calculating the bottom part of tanks. 11. Determining the stresses arising in the support ring. 12. Finding the stresses arising in the cross-sections of slabs, columns and girders. 13. Determining the reinforcement area according to the bending

	moment “M” and shear force “Q”. 14. Fundamentals of the research carried out to determine the properties of concrete and reinforcement. **III. Independent study and independent work (126 hours in total)** 1. General information on open and closed tanks. (14 hours) 2. Determining the complex stresses arising in the cross-sections of slabs, columns and girders. (16 hours) 3. Calculating the walls of cylindrical and rectangular tanks for the action of central and eccentric static and hydrostatic loads. (16 hours) 4. Calculating tanks for the action of dynamic forces. (16 hours) 5. Retaining walls and their types. (16 hours) 6. Strength calculation of reinforced concrete retaining wall structures according to the first limit state; (16 hours) 7. Determining the stresses arising in the wall and at the base of the wall and constructing the bending moment “M” diagram; (16 hours) 8. Determining the required working reinforcement area taking into account the effect of the stresses arising in the cross-sections of the main elements. (16 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 Special Metal Structures 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. 13 **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/