| Course title | Special Metal Structures (ECTS 6) |
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| **Subject/module code** | MMK1206 |
| Semesters in which the course is taught | Semester 3 |
| 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.**<br>**Classroom hours – 54.**<br>Lecture hours – 26<br>Practical class hours – 28<br>**Independent study – 126 hours** |
| ECTS | 6 |
| Aim and objectives of the course / learning outcomes | **Aim of the course:** to familiarize students with the design, fabrication and erection processes of various complex and special metal structures used in construction, and to provide the theoretical and practical knowledge necessary for ensuring their strength, stability and reliability.<br>**Objectives of the course:** to teach students the types of special metal structures and their applications, as well as design and calculation methods; to develop skills in assessing the strength and stability of structures under loads and external actions; and to instil in students, through practical and design assignments, the skills of independent thinking, problem solving and preparing technical documentation.<br>**Learning outcomes:**<br>*Professional competencies:*<br>1. Knows the types of special metal structures and their fields of application;<br>2. Understands and is able to apply the methodology of designing and calculating structures;<br>3. Designs special metal structures and prepares drawings on the basis of regulatory documents;<br>*Skills:*<br>4. Compares several solutions in terms of technical and economic performance and selects the most suitable one. |
| Course content (topics) | **I. Main theoretical part (Lectures)**<br>**Topic 1:** General information on special reinforced concrete structures. Metal structures. A brief history of the development of metal structures. Fields in which special metal structures are used, their specific features and the requirements placed on them. Organizational form of design.<br>**Topic 2:** Columns. Determining the characteristic values of permanent loads and the effects of wind and snow. The main middle part of a column – the shaft. The column head. Column bases.<br>**Topic 3:** Trusses. Determining the design forces arising in truss members. Calculation of truss joints.<br>**Topic 4:** Structures of single-storey industrial buildings. Fundamentals of designing industrial buildings and the main requirements for such design. Arrangement of the structural scheme of the frame. Layout of columns in plan.<br>**Topic 5:** Arrangement of frame bents. Specific features of calculating a transverse frame.<br>**Topic 6:** Loads acting on a frame. Determining permanent loads. Determining snow loads. Loads from cranes. Determining loads from wind pressure.<br>**Topic 7:** Calculation of frames. Calculating a transverse frame for permanent loads. Calculating a transverse frame for loads from the snow |

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| | layer. Calculating a frame for loads from cranes. Calculating industrial buildings with a roof structure of high rigidity as a spatial system. Calculating a frame for horizontal loads.<br>**Topic 8:** Calculation of transverse frame elements. Procedure for calculating a truss. Calculation of truss joints. Calculation of a crane runway beam. Calculation of a frame column. Calculation of the upper part of a column. Calculation of the lower part of a frame column.<br>**Topic 9:** Roof structures of large-span buildings. Beam structures working in a single plane for large spans. Frame structures. Arch structures.<br>**Topic 10:** Covering large-span buildings with spatial structures. Definition of the concept of limit state, design values of actions, properties of materials and geometric characteristics of structures, and rules for calculating strength and serviceability according to limit states. Domes. Space-frame (structural) systems. Calculation of space-frame structures.<br>**Topic 11:** Metal structures working in tension. Covering large-span buildings with tension structures. Single-chord tensile roof structures. Double-chord cable systems. Saddle-shaped roofs. Cable trusses. Steel membranes.<br>**Topic 12:** Frames of tall buildings. Frame system. Building frames with bracing elements. Systems with frames and bracing elements. Systems with a core in the middle part of the building frame. Tube (box) systems. Frame systems with external bracing trusses. Cross-sectional areas of the main elements. Calculation of frames of tall buildings.<br>**Topic 13:** Structures made of sheet steel. Distinctive features of sheet steel structures. Tanks. Vertical cylindrical low-pressure tanks. High-pressure vertical cylindrical tanks. Horizontal cylindrical tanks. Strength calculation of the walls of horizontal cylindrical tanks. Spherical tanks. Gasholders. Bunkers and silos.<br>**II. Practical class topics (2 hours each)**<br>1. Main properties of materials in special metal structures and the requirements placed on them. Organizational form of design.<br>2. Column sections. Cross-sectional areas of columns.<br>3. Determining the design forces arising in truss members by the method of moments and the method of joint sections. Calculation of truss joints.<br>4. Structures of single-storey industrial buildings. System of vertical bracing elements between columns.<br>5. Creating the design scheme of a frame. Specific features of calculating a transverse frame.<br>6. Determining the load acting on one square metre of the roof structure. Determining temporary and permanent loads.<br>7. Calculating permanent and temporary loads acting on a frame. Calculating a frame for loads from cranes. Calculating industrial buildings with a roof structure of high rigidity as a spatial system. Calculating a frame for horizontal loads.<br>8. Calculation of trusses. Calculation of truss joints. The bottom chord of a truss.<br>9. Beam structures working in a single plane for large spans. Methods of reducing the bending moment arising in a truss.<br>10. Types of spatial structures made of steel. Calculation of space-frame structures. Shells. Two types of shells.<br>11. Calculating tension structures for covering large-span buildings. Calculating single-chord tensile roof structures. Double-chord cable systems.<br>12. Calculating a frame system. Building frames with bracing elements. Systems with a core in the middle part of the building frame. |

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| | Calculation of frames of tall buildings.<br>13. Distinctive features of thin-walled steel structures. Types of vertical cylindrical low-pressure tanks. Horizontal cylindrical tanks. Strength calculation of the walls of horizontal cylindrical tanks. [Note: the original text of this item is cut off.]<br>14. Structural solutions and fundamentals of calculation of towers. Fundamentals of calculating masts. Supports of high-voltage power transmission lines.<br>**III. Independent study and independent work (126 hours in total)**<br>1. Special metal structures. (10 hours)<br>2. The head of a column. (10 hours)<br>3. Trusses. Determining the design forces arising in truss members. Calculation of truss joints. (12 hours)<br>4. Fundamentals of designing industrial buildings and the main requirements for such design. (12 hours)<br>5. Arrangement of frame bents. Specific features of calculating a transverse frame. (12 hours)<br>6. Loads acting on a frame. Determining snow loads. (10 hours)<br>7. Calculating industrial buildings with a roof structure of high rigidity as a spatial system. Calculating a frame for horizontal loads. (10 hours)<br>8. Calculation of truss joints. Calculation of a crane runway beam. Calculation of a frame column. (10 hours)<br>9. Beam structures working in a single plane for large spans. Frame structures. Arch structures. (10 hours)<br>10. Domes. Space-frame structures. Calculation of space-frame structures. Shells. Two types of shells. (10 hours)<br>11. Single-chord tensile roof structures. Double-chord cable systems. Saddle-shaped roofs. Cable trusses. Steel membranes. (10 hours)<br>12. Cross-sectional areas of the main elements. Calculation of frames of tall buildings. (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.<br>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.<br>**Assessment criteria:**<br>**a) To receive a grade of 5, the student's level of knowledge must meet the following:**<br>– can fully explain the essence and content of the subject;<br>– maintains scientific rigour and logic when presenting the topics of the subject, and avoids scientific errors and confusion;<br>– has a clear understanding of the theoretical or practical significance of the subject materials;<br>– can demonstrate the ability to think independently and freely within the subject;<br>– can give clear and concise answers to the questions asked;<br>– has prepared lecture notes thoroughly;<br>– has completed independent assignments fully and accurately;<br>– has mastered all practical skills and competencies;<br>– is able to apply theoretical knowledge in various situations;<br>– takes a systematic approach and follows continuity.<br>**b) To receive a grade of 4, the student's level of knowledge must** |

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| | **meet the following:**<br>– has understood the essence and content of the subject and avoids scientific and logical confusion when presenting the topics of the subject;<br>– has understood the practical significance of the content of the subject;<br>– performs the tasks and assignments given in the subject within the scope of the curriculum;<br>– can give correct answers to the questions asked on the subject;<br>– has compiled thorough lecture notes on the subject;<br>– has fully completed the independent assignments on the subject;<br>– has tried to master all practical skills and competencies.<br>**c) To receive a grade of 3, the student's level of knowledge must meet the following:**<br>– has a general understanding of the subject;<br>– covers the topics of the subject within a narrow scope and makes some confusions in presenting them;<br>– has fully completed the independent assignments on the subject;<br>– the presentation is not fluent;<br>– gives vague and confused answers to questions on the subject;<br>– the text on the subject has not been thoroughly prepared.<br>**d) In the following cases, a student's level of knowledge may be assessed as unsatisfactory, with a grade of 2:**<br>– has not prepared for classes in the subject;<br>– has no idea whatsoever about the classes in the subject;<br>– has not fully completed the independent assignments on the subject;<br>– it is evident that the texts on the subject were copied from others;<br>– serious errors and confusion are made in the text on the subject;<br>– no answer is obtained to the questions on the subject;<br>– 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.<br>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.<br>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.<br>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.<br>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**<br>1. Saydullayev Q.,Shukurova K. «Metall konstruksiylari». O‘quv qo‘ilanma. Toshkent, 2019 y.<br>2. Saydullayev Q.A.,Ganiyeva K.Q. «Maxsus metall konstruksiyalari». O‘quv qo‘llanma. Toshkent, 2016 y.<br>3. SHNQ 2.03.05-24. Pulat konsnruksiyalari. DAQQ, T., 2024 yil.<br>4. 2.01.07-21. Yuklar va ta'sirlar. QMQ DAQQ, T., 2021 yil |

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| | **Additional literature**<br>5. Xolmurodov R.I., Asliyev S.A. Metall qurilmalari. O‘quv qo‘llanma. Toshkent,1994 y<br>**Information sources**<br>6. www.ziyonet.uz<br>7. https://www.liraland.ru/video/lira/<br>8. http://www.setkov-psk.perm.ru/p15.htm<br>9. https://www.facebook.com/groups/lirasaprtraining/ |