Course title	**Testing, Repair and Commissioning of Engineering Systems (ECTS 4)**
Subject/module code	MTSTFT4704
Semester(s) in which the course is taught	7th semester (2026–2027 academic year)
Assigned instructor	Qutlimurodov U., associate professor; Pirnazarov I., acting associate professor, Department of Engineering Communications
Language of instruction	Uzbek
Course type	Elective
Study workload (including independent study)	**Total workload – 120 hours** **Contact hours – 48** Lecture hours – 24 Laboratory hours – none Practical class hours – 24 **Independent study – 72 hours** Course project – none
ECTS	4
Course aims and objectives / learning outcomes	The main aim of the "Testing, Repair and Commissioning of Engineering Systems" course is to develop students' professional competencies in the testing, adjustment, commissioning, technical operation and repair (technology and organisation) of the engineering systems of buildings and structures (water supply, sewerage, heating, ventilation and air conditioning, gas supply). **The objectives of the course are that the student:** – studies the regulatory documents on the testing and acceptance of engineering systems; – knows the methods of hydraulic, pneumatic and thermal testing of piping systems; – masters the testing, flushing and disinfection of water supply and sewerage systems; – acquires the skills of adjusting and starting up heating, ventilation and air-conditioning systems; – knows the requirements for strength and tightness testing of gas supply systems; – is able to prepare handover documentation and acceptance certificates; – is able to diagnose the technical condition of systems and select repair methods; – learns to develop maintenance and planned preventive maintenance schedules. **Prerequisites: (FIZ11204) Physics; (OM11210) Higher Mathematics.** **Learning outcomes:** **Professional competencies:** 1. Applies the regulatory requirements for the testing, acceptance and commissioning of engineering systems. 2. Is able to select methods for the hydraulic, pneumatic and thermal testing of pipelines and systems. 3. Diagnoses the technical condition of engineering systems and justifies the type of repair required. 4. Organises a system of maintenance and planned preventive maintenance. **Skills:** 5. Processes test results and prepares handover and acceptance certificates. 6. Ensures compliance with occupational safety requirements during testing, adjustment and repair work.
Course content (topics)	**I. Main theoretical section (Lectures) – 24 hours**

	Topic 1: Introduction. Purpose and objectives of the course "Testing, Repair and Commissioning of Engineering Systems". (2 hours) Classification and life cycle of the engineering systems of buildings. Regulatory documents on testing, acceptance and operation (ShNQ, KMK, O'zDSt). **Topic 2: Procedure for the acceptance and commissioning of engineering systems. (2 hours)** Certificates of concealed works, as-built documentation. Working and acceptance commissions and their duties. **Topic 3**: Methods of hydraulic and pneumatic testing of piping systems. (2 hours)** Determining the test pressure. Testing equipment (hydraulic test pumps, compressors, pressure gauges). Safety measures during testing. **Topic 4: Testing of internal cold and hot water supply systems. (2 hours)** Flushing and disinfection of water pipelines. Testing and start-up of pumping units. Commissioning. **Topic 5: Testing of internal sewerage and drainage systems. (2 hours)** Testing by the water-filling method. Exfiltration and infiltration testing of external sewer networks. Acceptance of manholes. **Topic 6**: Hydrostatic and thermal testing of heating systems. (2 hours)** Hydraulic adjustment (balancing) of heating systems. Start-up of heating substations and boiler houses. **Topic 7: Testing and adjustment of ventilation and air-conditioning systems. (2 hours)** Measuring air flow rate, pressure and velocity (Pitot tube, anemometer). Aerodynamic testing and preparation of the system certificate (passport). **Topic 8: Strength and tightness testing of gas supply systems. (2 hours)** Start-up of gas equipment. Safety requirements in gas facilities. **Topic 9: Fundamentals of the technical operation of engineering systems. (2 hours)** Maintenance system. Planned preventive maintenance (PPM). Monitoring of system performance. **Topic 10: Faults, wear and corrosion of engineering systems. (2 hours)** Technical diagnostics methods: thermography, ultrasonic testing, acoustic leak detection. Assessment of residual service life. **Topic 11: Types of repair: routine repair, major (capital) repair, reconstruction. (2 hours)** Pipe repair technologies: trenchless renewal, relining, polymer coatings. Post-repair testing. **Topic 12: Organisation of testing, repair and operation work. (2 hours)** Occupational safety. Energy efficiency and metering. Building management systems (BMS). ** Topics developed on the basis of the curricula of universities ranked in the TOP-300 of the QS and THE rankings: Al-Farabi Kazakh National University (QS – 98, THE – 210), course "Heat Engineering" (Faculty of Thermal Power Engineering, "Energy" programme). Topic 3 – regulatory and technical documentation and standardisation systems, methods and means of equipment testing and quality control; Topic 6 – installations, systems and complexes of high-temperature and heat-and-moisture technology.

II. Guidelines and recommendations for practical classes – 24 hours

Practical classes consolidate the theoretical material of the lectures and develop students' skills in preparing acceptance documentation, determining test parameters, processing test results and planning the maintenance and repair of engineering systems.

Recommended practical topics (2 hours each):

1. Preparing acceptance documentation for engineering systems (certificate of concealed works, as-built drawing).
2. Determining the test pressure for hydraulic testing of pipelines and developing a test programme.
3. Processing the results of hydraulic testing of an internal water supply system and preparing the test certificate.
4. Calculating the chlorine dose and water consumption for flushing and disinfecting water pipelines.
5. Calculating the permissible exfiltration (infiltration) of water when testing an external sewer network.
6. Evaluating the results of hydrostatic and thermal testing of a heating system.
7. Hydraulic balancing of a heating system: calculating balancing valve settings.
8. Processing air flow measurement results in a ventilation system and preparing the system certificate (passport).
9. Determining the parameters for strength and tightness testing of gas pipelines and evaluating the pressure drop.
10. Drawing up a planned preventive maintenance (PPM) schedule for engineering systems.
11. Assessing the technical condition of pipelines and calculating their residual service life from the corrosion rate.
12. Preparing a bill of quantities and a process (method) chart for repair work.

III. Laboratory classes

Laboratory classes are not provided for in the curriculum of this course.

IV. Independent study – 72 hours

Independent study develops students' ability to learn autonomously, to work with scientific and technical literature, regulatory documents and electronic resources, and to apply the knowledge gained in professional activity. Assignments are completed under the teacher's guidance in traditional or electronic form.

Topics recommended for independent study (6 hours each):

1. Analysis of current regulatory documents on the testing and acceptance of engineering systems.
2. Procedure for accepting completed construction projects into operation.
3. Testing equipment and measuring instruments and their metrological verification.
4. Specific features of testing systems assembled from polymer pipes.
5. Testing and acceptance of external water supply and sewerage networks.
6. Testing and start-up of heating networks and heating substations.
7. Certification (preparation of passports) of ventilation and air-conditioning systems.
8. Emergencies in engineering systems and methods of eliminating them.
9. Modern methods of technical diagnostics (thermography, acoustic methods).
10. Trenchless pipe repair technologies.

	11. Building management systems (BMS) and dispatch control. 12. Preparing an essay or presentation on an assigned topic. **V. Teaching technologies and methods** – lectures; – interactive case studies; – seminars (logical thinking, rapid question-and-answer sessions); – group work; – presentations; – individual projects.
Student assessment	Student assessment is based on the level of mastery of the learning materials during the semester and final assessment (tests, assignments, and written and oral work). Throughout the "Testing, Repair and Commissioning of Engineering Systems" course, students are assessed on a 100-point scale. Of this total, 50 points are allocated to current and midterm assessment (60% of these 50 points for ongoing assessment and independent study, and 40% for the midterm assessment), while 50 points are allocated to the final assessment. Students whose combined current and midterm score is below 30 points are not admitted to the final examination. A student who obtains 30 or more points in the final assessment is considered to have passed the course. **Assessment criteria:** **a) A grade of "5" (excellent) requires the student to:** – fully explain the essence and content of the course; – present the topics of the course in a scientific and logically consistent manner, without scientific errors or inaccuracies; – have a clear understanding of the theoretical or practical importance of the course material; – demonstrate the ability to think independently and freely within the scope of the course; – give clear and concise answers to the questions asked; – have a thoroughly prepared set of lecture notes; – complete independent assignments fully and accurately; – have mastered all the practical skills and competencies; – be able to apply theoretical knowledge in various situations; – take a systematic approach and maintain continuity. **b) A grade of "4" (good) requires the student to:** – understand the essence and content of the course and present its topics without scientific or logical inaccuracies; – understand the practical importance of the course content; – complete the tasks and assignments for the course within the scope of the syllabus; – give correct answers to the questions asked on the course; – have a well-prepared set of lecture notes for the course; – complete the independent assignments for the course in full; – have made an effort to master all the practical skills and competencies. **c) A grade of "3" (satisfactory) requires the student to:** – have a general understanding of the course; – cover the topics of the course within a narrow scope, allowing some inaccuracies in presentation; – complete the independent assignments for the course in full; – the presentation is not fluent; – answers to questions on the course are vague and confused; – the written work on the course is not carefully prepared. **d) A grade of "2" (unsatisfactory) may be given in the following cases:** – the student has not prepared for classes on the course;

	– the student has no understanding of the content of the classes; – the independent assignments for the course have not been completed in full; – there are signs that written work has been copied from others; – the written work contains serious errors and inaccuracies; – no answers are given to questions on the course, i.e. the student does not know the course.
Examination requirements	To earn the credits, the student must have fully mastered the theoretical and methodological concepts of the course, be able to present the results of analysis correctly, reason independently about the processes studied, complete the tasks and assignments given in the current and midterm assessment, and submit the final assessment assignment. Students who do not submit current assessment, midterm assessment and independent study assignments, or who score fewer than 30 points for these assignments and assessment components, are not admitted to the final assessment. Furthermore, a student who, without a valid reason, misses 25 percent or more of the contact hours allocated to the course will be withdrawn from the course, will not be admitted to the final examination, and will be considered not to have earned the relevant credits for the course. A student who fails the final examination or receives a score in the range of "0–29.9" for this examination is considered to have an academic debt.
Recommended literature	**Main literature:** 1. Meliyev B.O‘. Binolarning muhandislik jihozlari [Engineering Equipment of Buildings]. Textbook for higher education institutions. – Jizzakh, 2023. – 257 p. 2. Toshmatov N.U. Issiqlik va gaz ta’minoti tizimlari [Heat and Gas Supply Systems]. Textbook. – Tashkent, 2021. – 234 p. 3. Saydullayev S.R. Binolarning injenerlik kommunikatsiyalari [Engineering Communications of Buildings]. Textbook. – Jizzakh, 2022. – 246 p. 4. Musayev Sh.M. Issiqlik ishlab chiqarish uskunalari [Heat Generation Equipment]. Study guide for students of higher education institutions. – Tashkent: Lesson press, 2021. – 158 p. 5. Qutlimurodov U.M. Suv ta’minoti va oqava suvlarni oqizish tizimlari [Water Supply and Wastewater Disposal Systems]. Study guide. – Minus design group LLC, 2021. – 210 p. **Additional literature:** 6. KMK 3.05.01-97. Ichki sanitariya-texnik tizimlar [Internal Sanitary-Technical Systems]. – Tashkent: State Committee for Architecture and Construction of the Republic of Uzbekistan. 7. KMK 3.05.04-97. Tashqi suv ta’minoti va kanalizatsiya tarmoqlari va inshootlari [External Water Supply and Sewerage Networks and Structures]. – Tashkent: State Committee for Architecture and Construction of the Republic of Uzbekistan. 8. Current regulatory documents of the Republic of Uzbekistan in the field of construction. **Internet resources** 9. www.gov.uz – Government portal of the Republic of Uzbekistan. 10. www.lex.uz – National database of legislation of the Republic of Uzbekistan. 11. https://t.me/archbookuz