Course title	Fluid and Gas Mechanics (ECTS 8)
Subject/module code	SGM23408
Semester(s) in which the course is taught	3rd and 4th semesters (2026–2027 academic year)
Assigned instructor	Kholbutayev B., acting associate professor; Kholboyev Y., assistant, Department of Engineering Communications
Language of instruction	Uzbek
Course type	Compulsory
Study workload (including independent study)	**Total workload – 240 hours** **Contact hours – 96** Lecture hours – 48 (24 per semester) Laboratory hours – 24 (12 per semester) Practical class hours – 24 (12 per semester) **Independent study – 144 hours (72 per semester)** Course project – none
ECTS	8 (3rd semester – 4; 4th semester – 4)
Course aims and objectives / learning outcomes	**The aim of the course is to develop students' theoretical knowledge and practical skills concerning the fundamental physical and mechanical properties of liquids and gases; their states at rest and in motion; the laws of hydrostatics and hydrodynamics; the movement of liquids and gases in pipelines; and the determination of hydraulic resistance.** **The objectives of the course are that the student:** – studies the basic properties, physical and mechanical characteristics and states of liquids and gases; – studies the fundamental laws and equations of hydrostatics and hydrodynamics; – understands the principles governing the movement of liquids and gases in pipelines; – learns to determine the main parameters of fluid flow: velocity, flow rate, pressure and energy; – learns to determine frictional and local resistance in pipelines and to calculate hydraulic losses; – applies the laws of fluid and gas mechanics when calculating hydraulic equipment and pipelines. **Prerequisites: Physics; Mathematics.** **Learning outcomes:** **Professional competencies:** 1. Knows the laws governing liquids at rest and in motion and the methods of applying them to solve engineering problems. 2. Knows the physical properties of liquids and their practical applications. 3. Knows the behaviour of bodies in liquids and their interaction with liquids. 4. Knows the principles of uniform and non-uniform, steady and unsteady flow. **Skills:** 5. Performs quality control. 6. Ensures production safety.
Course content (topics)	**I. Main theoretical section (Lectures) – 48 hours** **3rd semester – 24 hours** **Topic 1: Introduction to fluid and gas mechanics. The International System of Units.** [3, 9] (2 hours) **Topic 2: Basic properties of liquids.** [1, 4] (2 hours) **Topic 3: Determination of liquid viscosity. The concept of internal friction. The ideal fluid and its properties.** [2, 10] (2 hours) **Topic 4**: Hydrostatic pressure and its properties. Pressure-measuring instruments.** [9] (2 hours)

	Topic 5: Hydrostatic pressure force acting on a flat surface.** [2, 10] (2 hours) **Topic 6**: Hydrostatic pressure force acting on a curved surface.** [3, 9] (2 hours) **Topic 7: The law of flotation of bodies in liquids. Archimedes' principle. Kinematics of fluid motion.** [6, 11] (2 hours) **Topic 8: Main problems and methods of hydrodynamics. Hydrodynamic similarity and modelling.** [3, 9] (2 hours) **Topic 9: Fluid flow and flow rate through a flow cross-section.** [1, 11] (2 hours) **Topic 10: Conservation of mass, energy and momentum in moving fluids. Bernoulli's principle.** [2, 6] (2 hours) **Topic 11: The Bernoulli equation for ideal and real fluid streams.** [3, 8] (2 hours) **Topic 12: Laminar and turbulent flow of liquids.** [2, 6] (2 hours) **4th semester – 24 hours** **Topic 1: Calculation of short pipelines.** [1, 8] (2 hours) **Topic 2: Calculation of simple pipelines.** [6, 11] (2 hours) **Topic 3: Calculation of long pipelines.** [3, 8] (2 hours) **Topic 4: Calculation of long pipeline networks.** [1, 6] (2 hours) **Topic 5: Calculation of the economical diameter of pipelines.** [1, 4] (2 hours) **Topic 6: Flow of liquid through a nozzle.** [2, 6] (2 hours) **Topic 7: Non-uniform flow of liquids in channels and canals.** [2, 9] (2 hours) **Topic 8: Non-uniform flow of liquids in open channels.** [1, 7] (2 hours) **Topic 9: Flow regimes of liquids.** [3, 8] (2 hours) **Topic 10: Uniform flow of liquids.** [4, 10] (2 hours) **Topic 11: The most hydraulically efficient cross-section. Maximum and minimum permissible mean velocities.** [5, 11] (2 hours) **Topic 12: Water-conveyance structures.** [4, 11] (2 hours) ** Topics taken from the curricula of universities ranked in the TOP-300 of the QS and THE rankings: Delft University of Technology (TU Delft, QS – 49), course "Drinking Water Treatment 1". 3rd semester, Topics 4–6 – hydrostatic pressure and its properties, pressure-measuring instruments, and hydrostatic pressure forces acting on flat and curved surfaces; 4th semester, laboratory work 1 – experimental study of Bernoulli's principle. **II. Guidelines and recommendations for practical classes – 24 hours** Practical classes consolidate the theoretical material of the lectures and develop students' skills in solving problems of hydrostatics and hydrodynamics and in calculating hydraulic resistance in pipelines. **3rd semester – 12 hours (2 hours each):** 1. Main physical properties of liquids: introduction and problem-solving. 2. Hydrostatics: introduction and problem-solving. 3. Hydrostatic pressure force acting on an arbitrary plane surface: introduction and problem-solving. 4. Hydrostatic pressure force acting on a curved surface: introduction and problem-solving. 5. Equilibrium of a body in a liquid: introduction and problem-solving. 6. Hydrodynamics: introduction and problem-solving. **4th semester – 12 hours (2 hours each):** 1. Problem-solving on ideal fluids.

	2. Problem-solving on real fluids. 3. Problem-solving on the laminar flow regime of liquids. 4. Problem-solving on the turbulent flow regime of liquids. 5. Hydraulic resistance in pipelines. 6. Frictional resistance along the length of pipelines: introduction and problem-solving. **III. Laboratory classes – 24 hours** Laboratory classes develop students' skills in the experimental study of fluid flow and in measuring the hydraulic parameters of pipelines. **3rd semester – 12 hours (4 hours each):** 1. Theoretical and experimental determination of the two flow regimes of a liquid. 2. Selection of water flow velocity in the pipes and channels of water treatment plant structures. 3. Familiarisation with the HM 112 fluid mechanics apparatus. **4th semester – 12 hours (4 hours each):** 1**. Experimental study of Bernoulli's principle. 2. Determination of the friction factor along a ½-inch galvanised steel pipe. 3. Determination of the resistance coefficient in a 20–32 mm PVC/polyethylene pipe during flow through a sudden contraction or expansion, depending on the direction of liquid flow. **IV. Independent study – 144 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. **3rd semester – 72 hours:** 1. Description and classification of the course. Properties of liquids. (8 hours) 2. Hydrostatics. Hydrostatic pressure and its properties. (8 hours) 3. Hydrostatic pressure force. Flotation of bodies in liquids. (8 hours) 4. Fundamentals of hydrodynamics. Fluid motion. (8 hours) 5. Description of fluid motion. (8 hours) 6. Specific mechanical energy of flow. (8 hours) 7. Hydraulic resistance. (8 hours) 8. Flow regimes of liquids. (8 hours) 9. Hydraulic roughness. (8 hours) **4th semester – 72 hours:** 1. Flow of liquids in pipelines. (8 hours) 2. The Bernoulli equation for ideal and real fluid streams. (8 hours) 3. Geometric, energy and physical interpretation of the Bernoulli equation. (8 hours) 4. Hydraulic losses. (8 hours) 5. Laminar and turbulent flow of liquids. The phenomenon of cavitation. (8 hours) 6. Local resistance. (8 hours) 7. Simple short pipelines of constant diameter: siphon, pump suction pipe, inverted siphon. (8 hours) 8. Uniform steady flow of liquids in open channels. (8 hours) 9. The differential equation of steady non-uniform fluid flow. (8 hours) **V. Teaching technologies and methods** – lectures; – interactive case studies; – seminars (logical reasoning, 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). In each semester of the "Fluid and Gas Mechanics" 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. Musayev Sh.M. Pumps and Pumping Stations. Textbook. – Tashkent: Lesson Press, 2020. 2. Meliyev B.O‘. Engineering Equipment of Buildings. Textbook for higher education institutions. – Jizzakh, 2023. – 257 p. 3. Qutlimurodov U.M. Water Supply and Wastewater Disposal Systems. Study guide. – Minus Design Group LLC, 2021. – 210 p. 4. Sultonov A. Use and Protection of Water Resources. Study guide for higher education institutions. – Jizzakh, 2023. – 157 p. 5. Saydullayev S.R. Engineering Communications of Buildings. Textbook. – Jizzakh, 2022. – 246 p. **Additional literature:** 6. Muhammadiev M.M., Nosirov F.J., Paluanov D.T., Juraev Q.S., Juraev S.R. Methodological Guide for Laboratory Work in the Course "Operation of Hydropower Equipment". – Tashkent: Tashkent State Technical University, 2013. 7. Omonov M. Welding Technologies. – Tashkent: Fan va texnologiya, 2021. – 212 p. 8. Kholiqov A.A. Lecture Notes for the Course "Pumps, Fans and Compressors". – Bukhara: Texnotasvir, 2019. – 140 p. 9. Baumann H.D. Control Valve Primer: A User's Guide. 4th ed. – Research Triangle Park (NC): ISA, 2009. 10. Menon E.S., Menon P.S. Working Guide to Pumps and Pumping Stations: Calculations and Simulations. – Burlington (MA): Gulf Professional Publishing, 2010. 11. Current regulatory documents of the Republic of Uzbekistan relating to the water supply sector. **Internet resources** 12. www.gov.uz – Government portal of the Republic of Uzbekistan. 13. www.lex.uz – National database of legislation of the Republic of Uzbekistan. 14. https://t.me/archbookuz