Course title	Refrigeration Supply (ECTS 4)
Subject/module code	SBT2204 (Master's programme)
Semester(s) in which the course is taught	3rd semester (2026–2027 academic year)
Assigned instructor	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 – 36** Lecture hours – 18 Laboratory hours – none Practical class hours – 18 **Independent study – 84 hours** Course work – none
ECTS	4
Course aims and objectives / learning outcomes	**The aim of the course is to provide information on supplying various buildings with clean air, creating an appropriate hygienic environment in rooms, and removing dust and various harmful substances from rooms. To master the course at the level of theoretical, practical and scientific-technical requirements, students first need knowledge of physical and chemical processes and phenomena.** **The objective of the course: the course "Refrigeration Supply" is based not only on the theory of fundamental sciences but also covers a set of engineering disciplines: technical thermodynamics, fluid and gas mechanics, heat and mass transfer, heating, heat supply and ecology.** **Prerequisites: (MEMF2304) Use of Alternative Energy Sources; (STT1106) Water Treatment Technologies; (MKZL1206) Modern Design of Engineering Communications.** **Learning outcomes:** **Professional competencies:** 1. Has a thorough command of the theoretical foundations of the course and is able to use calculation formulas and modern computational methods in solving practical problems. 2. Is able to design, test and adjust refrigeration systems and to eliminate faults in them. 3. Has the skills to carry out the technical, economic and structural analysis of the refrigeration systems being designed and to determine their operating mode. 4. Knows conventional refrigerants (e.g. freons) and their alternatives (natural refrigerants: ammonia, CO_2, propane). **Skills:** 5. Performs quality control. 6. Ensures production safety.
Course content (topics)	**I. Main theoretical section (Lectures) – 18 hours** **Topic 1**: Introduction to the course "Refrigeration Supply". (2 hours)** [1, 3] **Topic 2: Selection of indoor and outdoor design air parameters for the design of refrigeration systems. (2 hours)** [2] **Topic 3: Fundamentals of artificial refrigeration. (2 hours)** [2, 4] **Topic 4: Alternative refrigerants. (2 hours)** [1, 3] **Topic 5: Operation and main operating modes of refrigerating machines and installations. (2 hours)** [2] **Topic 6**: Recommendations for the servicing of small refrigeration units and air-conditioning systems. (2 hours)** [3, 4] **Topic 7: Recommendations for the installation and maintenance**

	of commercial and industrial refrigeration and air-conditioning systems. (2 hours) [2] **Topic 8: Special operations in the servicing of refrigeration equipment. (2 hours)** [4, 5] **Topic 9: Main faults and methods of eliminating them. (2 hours)** [2, 3] ** Topics developed on the basis of the curricula of universities ranked in the TOP-300 of the QS and THE rankings: National University of Singapore (NUS; QS – 8, THE – 17), course "Thermal Environmental Engineering" (psychrometrics, cooling load calculations, air-conditioning systems, vapour compression refrigeration, energy performance analysis) – Topic 1; Delft University of Technology (TU Delft; QS – 47, THE – 57), lecture 4.7.1 "HVAC Operation & Control" (installations, systems and complexes of high-temperature and heat-and-moisture technology) – Topic 6. **II. Guidelines and recommendations for practical classes – 18 hours** Practical classes consolidate the theoretical material of the lectures and develop master's students' skills in refrigeration calculations, assessing harmful substances and refrigerants, preventing refrigerant emissions, and the maintenance, air exchange and thermal insulation of refrigeration systems. **Recommended practical topics (2 hours each):** 1. Calculations required for refrigeration. 2. Main types of harmful substances and their effects on the human body. 3. Determining the amount of harmful substances released in a room. 4. Vapour-compression machines: properties and environmental performance of the main refrigerants. 5. Preventing refrigerant emissions to the atmosphere. 6. Maintenance and repair. 7. Identifying types of air flow. 8. Air exchange arrangements in buildings. 9. Thermal insulation materials for refrigeration systems. **III. Laboratory classes** Laboratory classes are not provided for in the curriculum of this course. **IV. Independent study – 84 hours** Independent study develops master's students' ability to learn autonomously, to work with scientific and technical literature, regulatory documents and electronic resources, and to apply the knowledge gained in research and professional activity. Assignments are completed under the teacher's guidance in traditional or electronic form. **Topics recommended for independent study (14 hours each):** 1. Designing the wastewater treatment technology of a metallurgical plant. 2. Designing the wastewater treatment technology of knitwear factories. 3. Designing the wastewater treatment technology of textile factories. 4. Designing the wastewater treatment technology of a sugar plant. 5. Separation of suspended particles by centrifugal force. 6. Anodic oxidation and cathodic reduction. **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 "Refrigeration Supply" 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. Safarov U.T., Yusupov A.H. Chorvachilik va oziq-ovqat mahsulotlarini sovutish uskuna va jihozlari hamda sovuqlik bilan ishlov berish texnologiyasi [Refrigeration Equipment and Cold Processing Technology for Livestock and Food Products]. Study guide. – Samarkand/Tashkent, 2023. – 236 p. 2. Karimov Q.F., Nurmatov T.B. Sovutish asoslari [Fundamentals of Refrigeration]. Study guide. – 2024. – 176 p. 3. Azizov D., Saydiev F. Sovutish texnikasi va sovutish tizimiga xizmat ko'rsatish asoslari [Refrigeration Engineering and Fundamentals of Refrigeration System Servicing]. Study guide. – Tashkent: Baktria press, 2017. – 176 p. 4. Ismanxodjaeva M.R., Nurmanov S.R. Sovuqlik bilan ta'minlash [Refrigeration Supply]. – Tashkent, 2023. – 136 p. **Additional literature:** 5. Mansurova Sh.P. Ventilyatsiya va havoni konditsiyalash tizimlari [Ventilation and Air-Conditioning Systems]. Textbook. – Jizzakh: So'g'diyona nashriyot matbaa uyi, 2023. – 153 p. 6. Nurmanov S.R., Usmonov Sh.A., Pirnazarov I.I. Ventilyatsiya va havoni konditsiyalash tizimlari [Ventilation and Air-Conditioning Systems]. Study guide. – Tashkent: Ijod-Press, 2019. – 512 p. 7. Ismanxodjaeva M.R. Ventilyatsiya va havoni konditsiyalash tizimlari [Ventilation and Air-Conditioning Systems]. Study guide. – Tashkent: Ijod-Press, 2022. – 315 p. 8. Rashidov Yu.K. Issiqlik, gaz ta'minoti va ventilyatsiya [Heat and Gas Supply and Ventilation]. Textbook. – Tashkent: Cho'lpon, 2010. – 143 p. 9. QMQ 2.04.05-97*. Isitish, ventilyatsiya va konditsiyalash [Heating, Ventilation and Air Conditioning]. State Committee for Architecture and Construction of the Republic of Uzbekistan. – Tashkent, 2011. **Internet resources** 10. www.gov.uz – Government portal of the Republic of Uzbekistan. 11. www.lex.uz – National database of legislation of the Republic of Uzbekistan. 12. www.mc.uz – Ministry of Construction and Housing and Communal Services of the Republic of Uzbekistan. 13. www.ziyonet.uz – Information and educational network of the Republic of Uzbekistan. 14. www.setkov-psk.perm.ru