Course title	Building Thermal Physics (ECTS 4)
Subject/module code	QIF3504
Semester(s) in which the course is taught	5th semester (2026–2027 academic year)
Assigned instructor	Mansurova Sh.P., associate professor, Department of Engineering Communications
Language of instruction	Uzbek
Course type	Compulsory
Study workload (including independent study)	**Total workload – 120 hours** **Contact hours – 48** Lecture hours – 24 Laboratory hours – 12 Practical class hours – 12 **Independent study – 72 hours** Course project – none
ECTS	4
Course aims and objectives / learning outcomes	**The aim of the course is to teach the physical processes that take place in a building and its elements, and the effect of these processes on the building and on people.** **The objective of the course is to master the features of how the indoor microclimate of rooms is formed and the methods that ensure its reliability and long-term durability.** **Prerequisites: Higher Mathematics; Physics.** **Learning outcomes:** **Professional competencies:** 1. Has knowledge of the physical and geological data for building design, the influence of climate on the space-planning and structural solutions of a building, and the use of regulatory documents on climate. 2. Has knowledge of the thermal properties of building materials, the theoretical foundations of heat flow through building envelopes and the assessment of the moisture regime of building structures. 3. Has knowledge and skills relating to the physical nature of light, the principles of setting standards for illuminance in buildings, the principles of designing structures that provide natural lighting of buildings, and the design of devices for controlling solar radiation in buildings. 4. Has knowledge of the theoretical foundations of creating a standard-compliant acoustic environment in buildings, the sound-absorbing properties of enclosing structures and engineering measures against noise. **Skills:** 5. Is able to determine the temperature and humidity regime of a room and the thermal properties of materials and structures, and to calculate the insolation time of a room. 6. Is able to carry out thermal calculations and select the optimal structural solution for building envelopes, taking into account the creation of a comfortable indoor microclimate. 7. Is able to select moisture regimes in order to identify condensation zones in building envelopes, and to select methods and means of protecting areas and buildings against noise.
Course content (topics)	**I. Main theoretical section (Lectures) – 24 hours** **Topic 1: Building climatology. (2 hours)** Influence of climate on the design of buildings and their external enclosing structures. Climatic and physical-geological data for building design. [2, 5] **Topic 2**: Elements of heat exchange. (2 hours)** Heat conduction. Forced and natural convection. Radiative heat exchange. [1, 5] **Topic 3: Standardisation of thermal resistance (resistance to heat transfer). (2 hours)**

Calculating the temperature distribution through the thickness of an enclosing wall. Heat transfer to the inner surface and materials of enclosing walls. [2, 4]

Topic 4: Air permeability of enclosing structures and materials. (2 hours)

Air permeability of external building envelopes. Air permeability of materials. [5, 6]

Topic 5: Moisture condition of external enclosing structures. (2 hours)

Moisture condensation on the inner surface of enclosing walls and measures to prevent it. [3, 4]

Topic 6: Vapour diffusion in building structures. (2 hours)**

Condensation of water vapour within the thickness of an enclosing wall and measures to prevent it. [1, 5]

Topic 7: Theoretical foundations of acoustics. (2 hours)

Types of acoustics. Room acoustics. [2, 3]

Topic 8: Building acoustics. (2 hours)

Principles of the acoustic design of rooms. Noise sources. [5, 8]

Topic 9: Lighting. (2 hours)

Artificial lighting. Use of daylight in rooms. Energy requirements for lighting. [2, 7]

Topic 10: Insolation. (2 hours)

Means of achieving optimal insolation and its standardisation. Solar coordinates. [5, 6]

Topic 11: Solar protection devices. (2 hours)

Construction and design of devices that protect a building from the sun. [5]

Topic 12: Thermal insulation materials for building envelopes. (2 hours)

Various thermal insulation materials and their heat and mass transfer properties. [5, 7]

** Topics developed on the basis of the curricula of universities ranked in the TOP-300 of the QS and THE rankings: Politecnico di Torino (QS – 240). Topic 2 – heat exchange elements: conduction, forced and natural convection; Topic 6 – vapour diffusion in building structures.

II. Guidelines and recommendations for practical classes – 12 hours

Practical classes consolidate the theoretical material of the lectures and develop students' skills in assessing climatic conditions, determining the thermophysical and moisture properties of building structures and calculating thermal insulation for building envelopes.

Recommended practical topics (2 hours each):

1. Comprehensive assessment of the climate of Uzbekistan.
2. Thermophysical properties of building structures.
3. Moisture penetration into building structures and methods of protection against it.
4. Selected engineering measures against noise.
5. Effect of solar radiation on people and their living environment.
6. Calculation of thermal insulation materials for building envelopes.

III. Laboratory classes – 12 hours

Laboratory classes develop students' skills in measuring and evaluating the parameters of the indoor microclimate.

Recommended laboratory topics (4 hours each):

1. Identifying comfort and discomfort zones in a room.
2. Determining indoor air humidity and the dew-point temperature.
3. Determining the microclimate parameters of a room.

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:** 1. Building climatology and heat transfer through the external enclosing structures of buildings. (2 hours) 2. Steady-state heat flow in the external enclosing structures of buildings. (4 hours) 3. Air permeability of the external enclosing structures of buildings. (2 hours) 4. Thermophysical properties of individual parts of external enclosing structures. (4 hours) 5. Moisture condition of external enclosing structures. (2 hours) 6. Water vapour diffusion in external enclosing structures. (4 hours) 7. Principles of designing external enclosing structures for winter conditions. (4 hours) 8. Relative and absolute humidity of air. (2 hours) 9. Unsteady (variable) heat flow in external enclosing structures. (2 hours) 10. Formation of moisture in external enclosing structures. (2 hours) 11. Condensation moisture. (4 hours) 12. Climatic regionalisation and zoning of territories. (2 hours) 13. Methods of heat transfer. (4 hours) 14. Thermal resistance of a homogeneous flat wall. (2 hours) 15. Heat absorption, thermal and heat-transfer resistances. (4 hours) 16. The field of lighting engineering and its main tasks. (4 hours) 17. Heat transfer by radiation and convection. (4 hours) 18. Development trends in lighting engineering. (2 hours) 19. The basic laws of light and their essence. (4 hours) 20. Light rays: types and physical nature. (2 hours) 21. Insolation and solar protection devices. (4 hours) 22. Overall light transmission coefficient. (2 hours) 23. Roof lights (skylights) of industrial buildings and the requirements for them. (2 hours) 24. Solar protection devices. (4 hours) **V. Teaching technologies and methods** – lectures; – interactive case studies; – seminars (logical thinking, rapid question-and-answer sessions); – group work; – presentations; – individual projects; – team projects for joint work and defence.
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 "Building Thermal Physics" 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 for assessment, and submit written work for the final assessment. 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	**Main literature:**

literature	1. Saydullayev S.R. Binolarning injenerlik kommunikatsiyalari [Engineering Communications of Buildings]. Textbook. – JizPI printing house, 2021. – 203 p. 2. Shukurov G‘.Sh., Islamova D.G. Qurilish issiqlik fizikasi [Building Thermal Physics]. Textbook. – Samarkand, 2014. – 226 p. 3. Madaliyev E.O‘. Issiqlik texnikasi [Heat Engineering]. Textbook. – Fergana: Farg‘ona, 2009. – 266 p. 4. Zohidov R.A., Alimova M.M., Mavjudova Sh.S. Issiqlik texnikasi [Heat Engineering]. Textbook. – Tashkent: O‘zbekiston faylasuflari milliy jamiyati, 2010. – 200 p. 5. Toshmatov N.U., Mansurova Sh.P., Obidov N.A. Qurilish issiqlik fizikasi [Building Thermal Physics]. Study guide. – Jizzakh: JizPI, 2025. – 124 p. **Additional literature:** 6. Boltayev J.B. Qurilish fizikasi [Building Physics]. Textbook. – Tashkent: Tafakkur avlodi, 2023. – 224 p. 7. Фокин К.Ф. Строительная теплотехника ограждающих частей зданий [Fokin K.F. Building Thermal Engineering of the Enclosing Parts of Buildings]. – Moscow: Stroyizdat, 1973. – 287 p. 8. Толстова Ю.И., Шумилов Р.Н. Основы строительной теплофизики [Tolstova Yu.I., Shumilov R.N. Fundamentals of Building Thermal Physics]. Study guide. – Yekaterinburg: Ural Federal University Publishing House, 2014. – 104 p. **Internet resources** 9. www.ziyonet.uz – Information and educational network of the Republic of Uzbekistan. 10. www.mc.uz – Ministry of Construction and Housing and Communal Services of the Republic of Uzbekistan.