Name of subject	**Modern Methods for Designing Engineering Utility Systems. (ECTS 6)**
Subject/module code	IKTLZU2406
Science taught semester (s).	4nd semesters
Responsible teacher	Saydullayev Sirojiddin Rahmatullayevich, Associate Professor
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-180.** **Audience Training hours - 72.** Lecture training hour – 24 Practical training hour – 48 **Independent education -108 hours**
ECTS	6
The purpose and tasks of subject / learning outcomes	**The purpose of teaching science -** The aim of the course is to develop students' theoretical knowledge and practical skills in designing engineering utility systems of modern buildings and structures, including heat supply, heating, ventilation, air conditioning, water supply, sewerage, gas supply and other systems, using modern digital technologies, automated calculation software and Building Information Modelling (BIM) technologies. **The Objectives of the Course** The objectives of the course are to provide students with theoretical knowledge and practical skills in the following areas: 1. To teach modern principles and methods of engineering utility systems design. 2. To teach the fundamentals of calculation and design of heating, ventilation, air conditioning, heat supply, gas supply, water supply and sewerage systems. 3. To develop practical skills in performing hydraulic, aerodynamic and thermotechnical calculations using modern methods. 4. To teach methods of coordinating the design of engineering utility systems with the architectural and structural elements of buildings. 5. To develop the ability to select modern engineering solutions aimed at improving energy efficiency and conserving resources. 6. To teach students how to assess the reliability, safety, environmental performance and economic efficiency of designed engineering systems. 7. To teach the principles of integrating modern automation and Smart Building technologies into engineering utility systems.
Course content (topics)	**1. Main Theoretical Part (Lecture Sessions)** **Topic 1:** Introduction. Alternative Energy Sources and Modern Approaches to the Design of Engineering Utility Systems. **Topic 2:** Digital Design Tools. **Topic 3:** Energy Calculations and Building Simulation. **Topic 4:** Design of Heating Systems: Hydronic and Air-Based Heating Systems. **Topic 5:** Modern Design of Domestic Hot Water Supply Systems. **Topic 6:** Ventilation Systems and Air Purification Technologies. **Topic 7:** Air Treatment and Distribution. **Topic 8:** Air Distribution System Control. **Topic 9:** Indoor Airflow and Diffusers. Design and Analysis of Air Duct Systems. **Topic 10:** Modern Methods for Designing Water Supply Systems.

Topic 11: Design of Internal and External Building Sewerage Networks.

Topic 12: Design of Wastewater Networks.

II. Practical training instructions and recommendations

The teacher's preparation for a practical training session begins with the study of preliminary documents (curriculum, thematic plan, etc.) and ends with the development of a lesson plan. The teacher should have an idea of the goals and objectives of the practical training session, the amount of work that each student must perform.

Methodological guidelines are the main methodological document of the teacher in preparing and conducting practical training sessions.

The purpose of the practical training session is to understand the theory, acquire skills. It is to consciously apply it in educational and professional activities, and to develop the ability to confidently form one's own point of view.

The following topics are recommended for practical training:

1. Development of a Structural Diagram of Building Engineering Utility Systems and Selection of Alternative Energy Sources.
2. Creating Digital Models of Heating System Equipment and Components Using Computer Software.
3. Creating Digital Models of Heat Supply Systems Using Computer Software.
4. Creating Digital Models of Gas Supply Systems Using Computer Software.
5. Creating Digital Models of Ventilation Systems Using Computer Software.
6. Creating Digital Models of Building Water Supply and Sanitary Systems Using Computer Software.
7. Assessment and Calculation of Building Heating Loads and Annual Energy Consumption.
8. Calculation of Building Heat Losses.
9. Calculation and Selection of Heating System Equipment and Radiators.
10. Hydraulic Calculation of Heating Systems.
11. Determination of the Heating Load of a Building and Selection of Radiators and Pipelines.
12. Determination of Hot Water Consumption, Selection of Pipe Diameters and Calculation of Circulation Systems.
13. Calculation of Required Air Exchange Rates for Rooms and Selection of Ventilation Equipment.
14. Selection of Air Handling Units and Representation of Air Treatment Processes on a Psychrometric Chart.
15. Development of an Automatic Control Algorithm for Ventilation Systems and Preparation of a Building Management System (BMS) Diagram.
16. Hydraulic Calculation of Air Ducts and Layout of Air Diffusers.
17. Hydraulic Calculation of Internal Building Water Supply Networks and Selection of Pipe Diameters.
18. Design of Internal Sewerage Networks and Determination of Pipe Diameters and Slopes.
19. Determination of Wastewater Flow Rates and Development of Sewer Network Routes and Longitudinal Profiles.
20. Development of Monitoring and Control Diagrams for Heating and Gas Supply Equipment Using BMS/SCADA Systems.
21. Development of Monitoring and Control Diagrams for Ventilation Equipment Using BMS/SCADA Systems.

22. Development of Monitoring and Control Diagrams for Sanitary Equipment Using BMS/SCADA Systems.

23. Verification of Engineering Utility System Designs in Accordance with Regulatory Documents and Identification of Safety Requirements.

24. Development, Technical and Economic Assessment, and Presentation of a Comprehensive Building Engineering Utility Systems Design Project.

IV. Independent learning and independent work.

Independent learning competence serves to support students' independent self-development and increase the effectiveness of professional activities. Students perform independent work on their mobile devices under the guidance of a teacher in a traditional or electronic form.

Recommended topics for independent study:

1. The Importance of BIM Technologies in the Design of Building Engineering Utility Systems.
2. Modern Principles of Designing Energy-Efficient Buildings.
3. Opportunities for Using Renewable Energy Sources in Buildings.
4. Design of Building Engineering Systems Using Solar Energy.
5. The Role of Engineering Utility Systems in Reducing Building Energy Consumption.
6. Application of Modern Software Tools in HVAC System Design.
7. Modelling Building Engineering Utility Systems Using Autodesk Revit MEP.
8. Methods of Building Energy Performance Simulation Using Software.
9. Determination of Building Heating Loads and Assessment of Energy Consumption.
10. Technical and Economic Comparison of Hydronic and Air-Based Heating Systems.
11. Design of Energy-Efficient Radiator Heating Systems.
12. Design of Heating and Cooling Systems Based on Heat Pumps.
13. Energy-Efficient Technologies in Modern Domestic Hot Water Supply Systems.
14. Efficiency of Circulation Systems in Domestic Hot Water Supply Systems.
15. Comparison of Natural and Mechanical Ventilation Systems in Buildings.
16. Energy Efficiency of Ventilation Systems with Heat Recovery.
17. Modern Air Purification Equipment and Its Applications.
18. Analysis of Psychrometric Processes in Air Handling Units.
19. The Importance of Aerodynamic Calculations in Air Duct Design.
20. Efficiency of Modern Diffusers and Air Distribution Devices.
21. Modern Design of Internal Building Water Supply Systems.
22. Automatic Pressure Control Technologies in Water Supply Systems.
23. Selection of Energy-Efficient Pumps and Assessment of Their Operational Performance.
24. Modern Methods for Designing Internal Building Sewerage Systems.
25. Design and Hydraulic Calculation of External Wastewater Networks.
26. Integration of Wastewater Reuse Systems into Building

	Engineering Utility Systems. 27. The Role of Building Management Systems (BMS) in Controlling Building Engineering Utility Systems.
Exam form	Written
Teaching/learning and examination requirements	Complete mastery of theoretical and methodological concepts and practical knowledge of the discipline, the ability to correctly reflect the results of analysis, independently reason about the processes being studied and carry out tasks in the current, intermediate forms of control and independent work, pass written work on the final control. When drawing up final exam questions, deviations from the content of the discipline program are not allowed. The bank of final exam questions for each discipline is discussed at the meeting and approved by the head of the department. No later than 1 week before the start of the final control, tickets signed by the head of the department, enclosed in an envelope, are sealed by the Dean's office and opened 5 minutes before the start of the exam in the presence of students. Final exam duration is 80 minutes. Answers to final exam questions are recorded in copybooks with the seal of the Dean's office. After completion of the final work, the work is immediately encrypted by a representative of the Dean's office, and the copybooks are handed over to the commission for verification. From the moment of completion of the final exam, a period of 72 hours is allotted for checking and posting the results on the electronic platform. The teacher who taught the students in this discipline is not involved in the process of conducting the exam and checking the students' answers. Student(s) who are dissatisfied with the final exam results may submit a written or oral appeal within 24 hours of the publication of the final exam results. Complaints submitted after 24 hours from the publication of the final exam results will not be accepted.
Scope of assessment criteria and procedure	CURRENT CONTROL Purpose: Determining and assessing the student's level of knowledge, practical skills, and competencies on course topics. Instructions: The student's activity in daily classes is assessed through the student's mastery of course topics, as well as constructively interpreting and analyzing the educational material, developing module-specific skills, acquiring practical skills (in terms of quality and the specified number) and competencies, solving problem situations aimed at applying professional practical skills, working in a team, preparing presentations, etc. Current control form: Activity in lessons Preparing educational materials Working with sources within the subject Using educational technologies Working in a team Preparing presentations Working with projects. MIDTERM CONTROL Purpose: Assessing the student's knowledge and practical skills and level of mastery of lecture material after completing the relevant section of the course. Form and procedure of intermediate control: Midterm examination is held during the semester during the training sessions after the completion of the relevant module of the curriculum of the subject. Midterm examination is held once in written form within the framework of this subject. Midterm examination questions cover all topics of the subject. INDEPENDENT LEARNING Purpose: Independent learning is aimed at fully covering the content of this course, expanding the theoretical knowledge acquired, and establishing independent learning activities for students.

Form and procedure of independent education: independent work assignments are completed in the form of an educational project, presentation, case study, problem solving, information search, digest, colloquium, essay, article, abstract, etc. Completed assignments for independent study are placed in the electronic system and checked based on the anti-plagiarism program and evaluated by the subject teacher.

In this case, the uniqueness of the completed assignment should not be less than 60%, otherwise the assignment will not be accepted for assessment. The number of independent work assignments, depending on the nature of the subject, should not be less than 3 for one subject (module). Independent work assignments account for 60% of the points allocated for current and intermediate control.

FINAL CONTROL

Purpose: The final examination is held at the end of the semester to determine the level of mastery of the student's theoretical knowledge and practical skills in the relevant subject. The final examination is held at a specified time according to the examination schedule created by the Registrar's Office on the electronic platform.

Requirements: The student must have passed the current control, intermediate control and independent learning assignments by the deadline for the final control type in the relevant subject. A student who has not passed the current control, intermediate control and independent learning assignments, as well as who has received a score in the range of "0-29.9" for these assignments and control types, is not included in the final control type. Also, a student who has missed 25 percent or more of the classroom hours allocated to a subject without a reason is excluded from this subject and is not included in the final control type and is considered not to have mastered the relevant credits in this subject. A student who has not passed or was not included in the final control type and has received a score in the range of "0-29.9" for this type of control is considered to be an academic debtor.

Final control form: The final examination in this subject will be conducted in written form. If the final examination is conducted in written form, the requirements for assessment must also be reflected.

Criteria for assessing student knowledge

5 grade	100 points		Assessment criteria
5	90-100	Excellent	When a student is considered to be able to make independent conclusions and decisions, think creatively, observe independently, apply the knowledge he has gained in practice, understand, know, express, and narrate the essence of the subject, and have an idea about the subject.
4	70-89,9	Good	When the student is considered to be able to observe independently, apply the knowledge he has gained in practice, understand, know, express, and narrate the essence of the subject, and has an idea about the subject.
3	60-69,9	Satisfactory	When the student is found to be able to apply the knowledge he has gained in practice, understands, knows, can express, and narrate the essence of the subject, and has an idea about the subject.

	2	0-59,9	Unsatisfactory	When it is determined that the student has not mastered the science program, does not understand the essence of the subject, and does not have an idea about the science.

Course assessment criteria and procedure

Assessment type	Total points allocated	Control (task) form	Distribution of points	Qualifying score
Current assessment	30 points	System tasks	20 points (divided by the number of tasks)	18 points
		Student activity (in seminars, practical, laboratory classes)	10 points	
Midterm assessment	20 points	Supervision: Written work	10 points	12 points
		System tasks	10 points (divided by the number of tasks)	
Final assessment	50 points	Written assignment (5 questions)	50 points (10 points per question)	30 points

* Note: 60% of the points allocated for current and intermediate control are allocated to independent work assignments. Independent work assignments are evaluated as system assignments through the electronic platform.

Recommended Literature

Main literature:

1. S.R.Saydullayev “Kompyuter dasturi asosida muhandislik kommunikatsiya tizimlarini hisoblash” O'quv qo'llanma. 2022 yil. JizPI
2. S.R.Saydullayev “Binolarning injinerlik kommunikatsiyalari” darslik. Toshkent 2021 yil
3. Boboev S, Shukurov G, Ismanhodjaeva M “Isitish”. Darslik. “Yangi asr avlodi” 2008 y, 298 b
4. U.M.Qutlimurodov. "Suv ta'minoti va oqova suvlarni oqizish tizimlari". Darslik. Toshkent-2021. T: Lesson press. 2021. 260 bet.
5. S.R.Saydullayev. "Issiqlik ta'minoti tizimlari (Issiqlik ta'minoti va issiqlik jarayonlari)". O'quv qo'llanma - 2021-Toshkent. 205 bet.

Additional literatures

6. Mirziyoyev Sh.M. 2019 — 2030-yillar davrida O‘zbekiston Respublikasining “yashil” iqtisodiyotga o‘tish strategiyasini tasdiqlash to‘g‘risidagi O‘zbekiston Respublikasi Prezidentining qarori, 04.10.2019 yildagi PQ-4477-son.
7. Mirziyoyev Sh.M. Tanqidiy tahlil, qat’iy tartib-intizom va shaxsiy javobgarlik – har bir rahbar faoliyatining kundalik qoidasi bo‘lishi kerak. O‘zbekiston Respublikasi Vazirlar Mahkamasining 2016 yil yakunlari va 2017 yil istiqbollariga bag‘ishlangan majlisidagi O‘zbekiston Respublikasi Prezidentining nutqi. //“Xalq so‘zi” gazetasi. 2017 y., 16 yanvar, №11.
8. O‘zbekiston Respublikasi Konstitutsiyasi. - T.: O‘zbekiston, 2017. - 46 b.
9. O‘zbekiston Respublkasini yanada rivojlantirish bo‘yicha Harakatlar strategiyasi to‘g‘risida. - T.:2017 yil 7 fevral, PF-4947-sonli Farmoni.
10. Rashidov Yu.K., Koroli M.A. “Isitish” o‘quv qo‘llanma 2000 yil.

	96b. 12. Tursunova U.X., Mamajonov T.M. «Issiqlik ta'minoti» o'quv qo'llanma, Toshkent, Talkin, 2004 y. 126 b. 13. Duffie J.A., Beckman W.A. – "Solar Engineering of Thermal Processes", New Jersey, 2013 14. McQuiston, F. C., Parker, J. D., Spitler, J. D. and Taherian H., Heating, Ventilating, and Air Conditioning: Analysis and Design; 7th Edition, John Wiley & Sons. ISBN 978-1-119-89414-8 15. Heating, Ventilating, and Air-Conditioning SYSTEMS AND EQUIPMENT ASHRAE, 1791 Tullie Circle, N.E., Atlanta, GA 30329 ISBN 978-1-936504-26-8 16. Walter Grondzik, PE, Editor ASHRAE *Air-Conditioning System Design Manual*. 17. ASHRAE£ HANDBOOK Heating, Ventilating, and Air-Conditioning SYSTEMS AND EQUIPMENT ASHRAE, 1791 Tullie Circle, N.E., Atlanta, GA 30329. 2016. Inch-Pound Edition ISBN 978-1-939200-26-6 **Internet resources:** 1. www.ziyonet.uz – national educational materials search site. 2. www.gov.uz – Government portal of the Republic of Uzbekistan. 3. www.google.com – international educational materials search site. 4. ww.twirpx.com – international educational materials search site.

№	Name of the Higher Education Institution	QS	THE	Topic Title in This Programme	Additional Topics Introduced Based on the Top 300 University Programme.	References
1	Based on the course "Design of Building Heating, Ventilation, and Air Conditioning Systems" offered by the University of Maryland, USA (ranked 112th).	267-o'rin		Topic 2. Digital Design Tools.	Digital Design Tools. Software tools used for the design of HVAC and sanitary systems. Calculation modules. Graphical interfaces. Project simulation. Methods for automating the design process and improving accuracy.	https://mage.umd.edu/sites/oaee.umd.edu/files/syllabi/ENPM625%202408%20Syllabus.pdf
				Topic 3. Energy Calculations and Building Simulation.	Energy Calculations and Building Simulation. Calculation of building energy requirements and analysis through software-based modeling.	