Name of subject	Thermal Engineering and Hydropower (ECTS 11)
Subject/module code	ITG12310
Science taught semester (s).	2nd and 3rd semesters
Responsible teacher	Baratov Laziz, assistant.
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours - 330 .** **Audience Training hours** - 132. Lecture hours - 48 Laboratory hours - 36 Practical hours - 48 **Independent education - 198 hours**
ECTS	11
The purpose and tasks of subject / learning outcomes	**The goal of teaching science** is to develop knowledge, skills, and competencies in non-energy fields in each student studying in these areas, appropriate to the profile of the field, in terms of the laws of thermodynamics, types of heat engines, their structure, operation in cycles, and thermodynamic processes and heat transfer that occur in them. **The task of the subject** is to teach students the theory of the operation of heat engines, the laws of energy circulation, cycles and structure of energy devices, the processes that occur in them, as well as heat transfer and the principles of operation of thermal energy devices. **Learning outcomes:** 1. Study the history and prospects of the development of the electric power system. 2. Get acquainted with the laws of thermodynamics. 3. Study the types, structure, and operation of heat engines in cycles. 4. Study the laws of energy circulation in power plants. 5. Heat transfer and the principle of operation of heat power plants.
Course content (topics)	**I. Main theoretical part (Lecture)** **Topic 1:** Introduction to the subject of "Heat Engineering and Hydropower". History and development trends of thermodynamics and heat engineering **Topic 2**: Heat capacity. Molecular-kinetic theory of heat capacity of gases. **Topic 3:** Law of conservation and circulation of energy. Amount of work and heat in a thermodynamic process. I-th law of thermodynamics. **Topic 4:** Analysis of basic thermodynamic processes. **Topic 5:** Isobar, isochoric, isothermal, adiabatic and polytropic processes. **Topic 6:** Definitions of the II-th law of thermodynamics. Direct and inverse periodicity. Thermal efficiency of a heat device **Topic 7:** Water vapor and its properties. H-s diagram of water vapor **Topic 8:** Steam turbine devices. Rankine cycle. Cycles of a steam turbine device. **Topic 9:** Gas turbine device. Cycles of a gas turbine device. **Topic 10:** Fundamentals of heat transfer. Basic concepts. Heat transfer methods: heat conduction, convective heat transfer, radiation. Heat transfer. **Topic 11:** Fundamentals of convective heat transfer. Convective heat transfer **Topic 12:** Heat transfer. Heat transfer of a single and multi-layer flat wall under the boundary condition of the third order**.** **Topic 13:** Basic laws of heat transfer by radiation.

	Topic 14: Heat exchange devices. Types of heat exchange devices. Recuperative, regenerative and mixed heat exchange devices. **Topic 15:** Compressors, their types, structure and operating methods **II. Instructions and recommendations for organizing laboratory exercises.** In laboratory classes, students develop practical skills and competencies in various indicators of processes in electrical networks and systems, conducting experiments, calculating and drawing tables and graphs. The proposed topics are selected based on opportunities and conditions. **Recommended topics for laboratory work:** 1. Pressure and temperature measuring instruments; 2. Verification of the Boyle-Mariotte law; 3. Determination of the mass heat capacity of air; 4. Determination of the thermal conductivity of an insulating material; 5. Determination of the thermal conductivity of a horizontal pipe; 6. Operation of a single-stage piston compressor; **III. Instructions and recommendations for practical training** The teacher's preparation for a practical training begins with the study of the initial 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, the amount of work that each student must perform. Methodological instructions are the main methodological document of the teacher in preparing and conducting practical training. The purpose of a practical training 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**.** **Recommended practical topics:** 1. State parameters and equation of state; 2. Heat capacity 3. Isobar, isochoric, isothermal processes, 4. Adiabatic and polytropic processes; 5. Carnot cycle 6. Steam turbine device. Rankine cycle. 7. Heat transfer. 8. Heat exchangers. **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. **Independent study for recommended topics:** 1. Ideal gas equation of state 2. Ideal gas mixtures 3. Heat capacity of ideal gases 4. I-law of thermodynamics 5. Isobaric, isochoric, isothermal, adiabatic and polytropic processes 6. II-law of thermodynamics 7. Cyclic processes. Carnot cycle 8. Heat conductivity of a flat wall and a cylindrical wall 9. Heat transfer 10. Laws of radiation. 10. Heat exchangers. 11. Gas turbine devices.

	12. Compressor devices.
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. Kleein., G.Nellis. Thermodynamics. Cambridge, 2012
2. Alimova M.M., Mavjudova Sh.S., Isaxodjayev X.S., Raximjonov R.T., Umarjonova F.Sh. «Issiqlik texnikasining nazariy asoslari» fanidan tajriba ishlari to'plami. Uslubiy qo'llanma, 1-qism.-T.: Toshkent, ToshDTU, 2006.
3. Koroli M.A., Umarjonova F. Sh., Xoshimova F.A. Termodinamika. Issiqlik texnikasi. darslik. - Toshkent: BOOK TRADE KO, 2022
4. Mavjudova Sh.S. Termodinamika va issiqlik texnikasi. Darslik, – Toshkent.: Fan va texnologiyalar nashriyoti-matba uyi, 2022
5. Mavjudova Sh. S. Issiqlik texnikasi, O´quv qo´llanma.-Toshkent: O´zbekiston faylasuflari milliy jamiyati nashiriyoti, 2023.
6. Umarjonova F. Sh., Isaxodjaev X. S., Mavjudova Sh. S., Alimova L.O., Axmatova S. R. "Issiqlik texnikasi" fanidan laboratoriya ishlari to'plami. Uslubiy qo'llanma. – Toshkent, ToshDTU. 2014-94 b.
7. Uzoqov G'.N., Qodirov I.N., Isaxodjaev X.S.. Termodinamika. O'quv qo'llanma -Toshkent: Voris- Nashiriyot, 2018.
8. Zohidov R.A., Alimova M.M., Mavjudova SH.S. Texnik termodinamika va issiqlik uzatilishi fanidan masalalar to'plami. – Toshkent.: TDTU, 2006.

Additional literature

1. Mirziyoyev Sh.M. Yangi O'zbekiston taraqqiyot strategiyasi. 2-to'ldirilgan nashr. – T.: O'zbekiston, 2022. – 44 b.
2. Islom Karimov nomidagi Toshkent davlat texnika universiteti talabalari mustaqil ta'limni tashkil etish bo'yicha Tartibi. – T.: ToshDTU, 10.06.2024. – 6 b.
3. В.П.Белоглазов. Теоретические основы теплотехники. Теплопередача. Нижневартовск, 2016
4. А.А.Яновский. Теплотехника. Уч. пособие. Ставрополь. 2020
5. Koroli M.A., Mavjudova SH.S. Zamonaviy pedagogik texnologiyalar. Metodik ishlanma. -Tashkent.: TDTU, 2003.

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	17. www.gov.uz – O‘zbekiston Respublikasining hukumat portali. 17. www.google.com – xalqaro o‘quv materiallarini qidiruv sayti. 19. www.energystrategy.ru – “Energetika siyosati va strategiyasi” axborot portali 20. www.twirpx.com – xalqaro o‘quv materiallarini qidiruv sayti.