Name of subject	**Thermal engineering and hydropower (ECTS 10)**
Subject/module code	ITG12310
Science taught semester (s).	2nd and 3rd semesters
Responsible teacher	Nurullayev Orzikul Ubayevich, Senior teacher.
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-300.** Audience Training hours - 120. Lecture training hour –60 Laboratory training hour – 30 Practical training hour – 30 **Independent education -180 hours**
ECTS	10
The purpose and tasks of subject / learning outcomes	**The goal of teaching science** is to develop knowledge, skills, and competencies in the energy sector in each student studying in these areas, including the laws of thermodynamics, the structure of types of heat engines, their operation in cycles, and the thermodynamic processes and heat transfer that occur in them. **The task of the subject** is to prepare students for the development and analysis of a module on the main technical and economic indicators of thermal power plants and their use in energy production, as well as economic issues. **Learning outcomes:** 1. Heat capacity. Gas mixtures. Heat capacity. Mayer equation. 2. Ideal gas mixtures. 1st law of thermodynamics. 2nd law of thermodynamics. Enthalpy. Entropy. Analysis of basic thermodynamic processes is studied. 3. Water vapor and its properties. Thermal conductivity. Heat transfer is studied. 4. Brief historical information on hydropower is studied. 5. Basic concepts of hydrometry. 6. Heat energy devices. 7. Heat exchange devices. 8. Compressor. General information about compressors.
Course content (topics)	**I. Main theoretical part (Lecture)** **Topic 1**: Introduction. The role of thermal energy devices in agriculture. The first law of thermodynamics The second law of thermodynamics. **Topic 2:** Heat capacity. Mixtures of gases. Heat capacity. Mayer's equation. Actual and average heat capacities. Empirical expressions of gas heat capacities. Dependence of heat capacity on process and temperature. **Topic 3**: Ideal gas mixtures. Dalton's law. Methods of expressing the composition of a mixture. Expression of the composition of a mixture in terms of its components. **Topic 4**: The 1st Law of Thermodynamics. The law of conservation and circulation of energy. The amount of work and heat in a thermodynamic process. **Topic 5:** Enthalpy. Entropy. Analysis of basic thermodynamic equations. **Topic 6**: The 2nd law of thermodynamics. Cyclic processes. Direct cycle efficiency. **Topic 7:** Water vapor and its properties. The transition of a substance from a liquid state to a vapor state. Dry or wet

state.

Topic 8: Thermal conductivity. Fourier's law. Convective heat exchange

Topic 9: Heat transfer. Heat exchange devices. Heat conductivity. Convection. Radiation.

Topic 10: Heat power devices. Internal combustion engines

Topic 11: Convective heat exchange methods.

Topic 12: Radiation. Radiation methods.

Topic 13: Heat power devices.

Topic 14: Heat exchange devices.

Topic 15: Compressor. General information about compressors

Topic 16: Cycles of refrigeration machines and compressors.

Topic 17: Fuel. Fundamentals of combustion.

Topic 18: Fuel composition and properties.

Composition of solid fuel. Working, dry, combustible and organic masses of fuel

Topic 19. Heat pumps.

Topic 20. Brief historical information on hydropower.

Topic 21. Climatic (weather) and geographical conditions of Uzbekistan.

Topic 22. The complex level of water in agriculture and energy.

Requirements for the complex use of water resources and their protection.

Topic 23: Hydropower plants.

General information about the method and equipment for quality control of the main parameters of (GEQ).

Topic 24: Basic concepts of hydrometry. Classification of hydropower research. Hydrometric devices.

Topic 25: Classification of hydrometric stations and posts and their location

Topic 26: Concept of rivers. Character of the distribution of river water velocity.

Topic 27: Calculation of morphometric characteristics of the construction of the longitudinal section of the river bed.

Topic 28: Hydrometric buoys (poplavki. Information about control measuring instruments.

Topic 29: Methods and instruments for measuring water depth. Concept of heat exchange devices.

Topic 30: Instruments used to measure water velocity.

II. Recommendations for practical exercises

The following topics are recommended for practical exercises:

Topic 1: State parameters and equation of state.

Topic 2: State parameters of an ideal gas. Mixture of gases.

Topic 3: Heat capacity

Topic 4: Isobaric process. Isobar, Isochar, Isothermal processes.

Topic 5: Carnot cycle:

Topic 6: Internal combustion engine cycles.

Topic 7: 1st-2nd law of thermodynamics. Cyclic processes. Direct cycle efficiency. ..

Topic 8: Heat transfer of flat walls and cylindrical walls.

Topic 9: Water vapor and its properties. Transition of a substance from a liquid state to a vapor state. Dry or wet state.

Topic 10: Heat transfer.

Topic 11: Transition of a substance from a liquid state to a vapor state

Topic 12: Convective heat transfer.

Topic 13: Internal combustion engines

Topic 14: Working, dry, combustible and organic masses of fuel

Topic 15: General information about the quality control method and equipment for the main parameters of hydropower plants (HPG).

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. **III. Instructions and recommendations for organizing laboratory exercises.** **Recommended topics for laboratory work:** Topic 1: State parameters and equation of state. Topic 2: State parameters of an ideal gas. Mixture of gases. Topic 3: Heat capacity Topic 4: Isobaric process. Isobar, Isochar, Isothermal processes. Topic 5: Carnot cycle. Topic 6: Internal combustion engine cycles. Topic 7: 1st-2nd law of thermodynamics. Cyclic processes. Direct cycle efficiency. Topic 8: Heat transfer of flat walls and cylindrical walls. Topic 9: Water vapor and its properties. Transition of a substance from a liquid state to a vapor state. Dry or wet state. Topic 10: Heat conductivity. Topic 11: Transition of a substance from a liquid state to a vapor state Topic 12: Convective heat transfer. Topic 13: Internal combustion engines Topic 14: Working, dry, combustible and organic masses of fuel Topic 15: Hydropower plants. (GEQ) General information about the quality control method and equipment of the main parameters. **IV.The following topics are recommended for practical training**: **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. The role and importance of thermal power plants in the development of the energy sector in Uzbekistan. 2. Problems in thermal power plants. 3. The role of thermodynamic processes in energy development. 4. The history of thermal power plants and their development. 5. Steam turbine heat supply systems. 6. Gas turbine heat supply systems. 7. Steam-Gas heat boilers and their development. 8. Modern heat transfer and exchange devices. 9. Evolution of thermal power plants in the age of high technologies. 10. Plans for the development of the renewable energy sector in Uzbekistan until 2030. 11. Use of renewable energy sources in agriculture and water management. 12. Resource indicators of renewable energy sources in the Republic of Uzbekistan. 13. Modern equipment for measuring thermal power plants. 14. Modern state of solar thermal power plants

	15. Primary energy resources and ways of their rational use 16. The importance of natural gas and coal in the production of thermal energy 17. Resource indicators of non-renewable energy sources in the energy sector of Uzbekistan.
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., Majduvova Sh.S, Isakhodjayev Kh.S, Rakhimjonov R.T, Umarjonova F.Sh. Collection of experimental works on the subject "Theoretical foundations of heat engineering". Methodological manual, Part 1.-T: TDTU, 2006.

3. Umarjonova F. Sh., Isakhodjayev Kh. S, Majduvova Sh. S, Alimova L, O, Akhmatova S. R. Collection of laboratory works on the subject "Theoretical foundations of heat engineering". Methodological manual. -Tashkent, Tashkent State Technical University. 2014 - 94 p.

4. Zohidov R.A, Alimova M.M, Majduvova Sh.S., Theoretical foundations of heat engineering. Textbook.-Tashkent: Publishing House of the National Society of Philosophers of Uzbekistan. 2010.

5.Zoxidov P.A.. Avezov P.P, Vardiyashvili A.B, Alimova M.M. "Theoretical foundations of heat engineering" Textbook.

Part 1.-T: TGTU, 20

6.Zoxidov R.A., Alimova M.M., Majudova Sh.S. Collection of problems on technical thermodynamics and heat transfer, - Tashkent: TDTU,

2006.

7.Кудинов В.А Э.М.Карташов. Техническая термодинамика. - М.: Высшая школа. 2005.

8.Muxammadiyev M.M. Xamdamov B.Mamatqulov D.A Gidroenergetika izlanishlari geodeziya.Toshkent-2020yil 234-bet

9.Xamdamov B .Gidroenergetik izlanishlari geodeziya.Amaliy mashg'ulot uslubiy ko'rsatmalar. Tashkent-2021y 68-bet

Additional literature:

10. Mirziyoyev Sh.M. Yangi O'zbekistonda erkin va farovon yashaylik. –T.: "TASVIR nashriyot uyi", – 2021.– 50 b.

11. Mirziyoyev Sh.M. Milliy taraqqiyot yo‘limizni qati’yat bilan davom ettirib yangi bosqichga ko‘taramiz .–T.:“O‘zbekiston”, 2017–592 b
12. Decree of the President of the Republic of Uzbekistan dated January 28, 2022 No. PF-60 “On the Development Strategy of New Uzbekistan for 2022-2026”.
13. Decree of the President of the Republic of Uzbekistan No. PF-220 dated 09.09.2022 “On additional measures for the introduction of energy-saving technologies and the development of small-capacity renewable energy sources”.

Information sources:

www.gov.uz - Government portal of the Republic of Uzbekistan.

www.lex.uz - National database of legislative documents of the Republic of Uzbekistan.

www.prezident.uz - Press service of the President of the Republic of Uzbekistan.

www.scopus.com - international scientific database.