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
Study to the program connection	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.
Student assessment	Assessment of student knowledge is based on the mastery of the learning material during the semester and final control (tests, assignments, written and oral work results). During the course of Electrical Networks and Systems, students are evaluated on a 100-point system. Of these, 50 points are allocated to the current and intermediate results (60% of 50 points are current control, independent study and 40% are intermediate control), and 50 points are allocated to the final control results. Students whose total score of current and intermediate points is less than 30 points are not admitted to the final control exam. A student who scores 30 or more points in the final control is considered to have mastered the subject.
Requirements for exams	The student must have fully mastered the theoretical and practical concepts of the subject, be able to correctly reflect the results of the analysis. The student must have completed the tasks given in the current and intermediate forms of independent work, assessment. At the same time, he must have received the necessary points from the current, intermediate, independent education and final tests in the relevant subject within the specified time. A student who has not submitted current control, intermediate control and independent education tasks, as well as who has scored less than 30 points on these tasks and types of control, will not be included in the final type of control. Also, a student who has missed 25 or more percent of the classroom hours allocated to the subject without an excuse will be expelled from this subject, will not be allowed to take the final exam and will be considered as not having mastered the relevant credits in this subject. A student who fails the final exam or scores less than 30 points on this type of exam is considered academically indebted.
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.