Course title	Heat Generation Equipment (ECTS 4)
Subject/module code	IICHU3604
Semester(s) in which the course is taught	6th semester (2026–2027 academic year)
Assigned instructor	Xamitov F., 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 – none Practical class hours – 24 **Independent study – 72 hours** Course work – yes
ECTS	4
Course aims and objectives / learning outcomes	**The aim of the course is for students studying in the agricultural field at higher education institutions to study the course "Heat Generation" and to gain an understanding of the selection of thermal equipment and of the role of the course in industry.** **The objective of the course is to teach students how to improve heat generation from the standpoint of energy efficiency in line with modern requirements, to justify its use for various purposes, to increase the efficiency of equipment while preserving its technical properties, and to gain skills and experience in ensuring energy-saving technologies in production.** **Prerequisites: Physics; Mathematics.** **Learning outcomes:** **Professional competencies:** 1. Analyses the basic concepts, laws and thermodynamic processes of heat generation. 2. Is able to identify the types of heat transfer processes and the laws governing them. 3. Analyses the operating principles of heat engines, heat exchange devices and energy systems. 4. Is able to calculate the main thermodynamic and thermal engineering parameters of heat-generating installations. **Skills:** 5. Performs quality control. 6. Ensures production safety.
Course content (topics)	**I. Main theoretical section (Lectures) – 24 hours** **Topic 1: Introduction. Conventional energy sources. (2 hours)** The role and importance of the course "Heat Generation Equipment". The place of heat energy generation equipment in everyday life. [1, 3] **Topic 2**: Heat energy sources. Various forms of energy storage. (2 hours)** Heat energy sources for heat supply networks; fuel and fuel resources. Their classification and the main areas of their use. [2, 3] **Topic 3: Thermal energy resources and the thermal energy balance. (2 hours)** Thermal energy resources and their classification. Secondary heat energy sources. Renewable and non-renewable thermal energy resources. Main methods of fuel extraction. [3, 5] **Topic 4: Fundamentals of the combustion of organic fuels. (2 hours)** The process of heat energy generation and its calculation. Methods of heat energy generation. [2, 3] **Topic 5**: Fundamentals of solar energy. Methods of heat energy**

generation. (2 hours)

Fundamentals of solar energy. Standard (reference) fuel. Solid fuels and their classification. Composition of coal; physical properties of solid fuel. [1, 4]

Topic 6: Heat generation equipment. (2 hours)

Classification of methods. Schemes of heat energy generation from organic fuel: schemes of combined generation of electricity and heat; schemes of heat energy generation at thermal power plants. [2, 4]

Topic 7: Thermal calculation of heat generation equipment operating on organic fuel. (2 hours)

Design and verification calculation of heat generators. The standard method of thermal calculation – the calculation procedure. Material balance of fuel combustion. [4, 5]

Topic 8: Heat generation equipment. (2 hours)

General physico-chemical foundations of the theory of fuel combustion; basic concepts and definitions; chemical reactions as the basis for obtaining heat energy from organic fuels. [1, 5]

Topic 9: Furnaces and burners. (2 hours)

Main development trends of heat generation equipment operating on organic fuels. Heat generation equipment for individual heat supply systems. [1, 4]

Topic 10: Convective heating surfaces of heat generation equipment. (2 hours)

Furnaces: main indicators and classification; furnaces with layer (grate) firing and their classification; chamber furnaces and their classification. [2, 3]

Topic 11: Fuel facilities of thermal power plants operating on organic fuels. (2 hours)

Thermal regime of the walls of heating surfaces. Scale formation and ash deposition on the walls of heating surfaces. High- and low-temperature corrosion. [1, 4]

Topic 12: Water regime of heat generation equipment. (2 hours)

General principles of organising fuel facilities. Fuel facilities of heat generators operating on solid and gaseous fuels; their basic schemes. [3, 5]

** Topics developed on the basis of the curricula of universities ranked in the TOP-300 of the QS and THE rankings: Delft University of Technology (TU Delft, QS – 49), course “Fluid Flow, Heat & Mass Transfer”. Topic 2 – thermodynamic processes, the concept of heat capacity, the equation of state, the Mendeleev–Clapeyron equation; Topic 5 – Fourier’s law, thermal conductivity, heat flow through single-layer and multilayer flat walls, the Newton–Richmann law and the heat transfer coefficient.

II. Guidelines and recommendations for practical classes – 24 hours

Practical classes consolidate the theoretical material of the lectures and develop students’ skills in the thermal calculation of heat generation equipment: fuel combustion, heat balance, efficiency, heat exchange in the furnace and on convective surfaces, and the thermal scheme of the equipment.

Recommended practical topics (2 hours each):

1. Calculating the change in the heat of combustion when the fuel composition is converted from one basis to another.
2. Calculating the components of the heat balance of equipment.
3. Calculating the efficiency of heat generation equipment.
4. Determining the heat losses with flue gases, from chemical and mechanical incomplete combustion, and to the surroundings.
5. Calculating heat exchange in the furnace of the equipment.

6. Determining the theoretical temperature of fuel combustion.
7. Calculating the diameter of a boiler-house chimney.
8. Determining the temperature of flue gases leaving the furnace and the amount of heat absorbed by the furnace.
9. Calculating heat exchange on the convective surfaces of the equipment.
10. Developing and calculating the thermal scheme of the equipment.
11. Modern types of heat generation equipment.
12. Obtaining heat energy using solar energy.

III. Laboratory classes

Laboratory classes are not provided for in the curriculum of this course.

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 (4 hours each):

1. Alternative organic fuels.
2. Artificial fuel: composite fuels and their classification.
3. Synthetic fuels and their classification.
4. Use of waste and biomass as energy fuel.
5. Nuclear fuel and its types.
6. Schematic diagrams of heat energy generation from agricultural waste.
7. Schematic diagrams of heat energy generation from municipal waste.
8. Operating principles of nuclear heat generators.
9. Heat exchange calculation of nuclear heat generators.
10. Fluidised-bed furnaces.
11. Vortex and cyclone furnaces.
12. Fuel facilities.
13. Types of agricultural waste.

V. Course work

Topic: "Thermal engineering calculation of heat generation equipment".

The aim of the course work is to develop students' ability to work independently, to build practical skills in applying the theoretical knowledge gained, to make technical decisions suited to real production conditions, and to gain skills in using modern equipment and technologies. The topics of the course work correspond to the technical calculation of heat generation installations in the technological processes of industrial enterprises. Each student receives an individual assignment. The calculation and graphic work is carried out using modern computer software.

The graphic part of the course work consists of 1–2 sheets of A2 drawing paper showing, without scale, the scheme, plan and section of the heat-generating equipment and chambers, the installation diagram and the network connection diagrams. The explanatory note is 20–25 pages of A4 paper and is prepared in accordance with the following requirements:

– paper size – A4 (210 × 297 mm);
– margins – 2.5 cm on the left; 2 cm on the right, top and bottom;
– font – Times New Roman;
– page numbering – at the bottom centre of the page;
– font size – 14 for the main text;
– paragraph indent – 1.25 cm;

	– line spacing – 1.5; – text alignment – justified; – language – Uzbek (Latin script); – font size in drawings and tables – 12. **VI. Teaching technologies and methods** – lectures; – interactive case studies; – seminars (logical thinking, rapid question-and-answer sessions); – group work; – presentations; – individual projects.
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 "Heat Generation Equipment" 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 in the current and midterm assessment, and submit the final assessment assignment. 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 literature	**Main literature:** 1. Musayev Sh.M. Issiqlik ishlab chiqarish uskunalari [Heat Generation Equipment]. Study guide for students of higher education institutions. – Tashkent: Lesson Press, 2021. – 158 p. 2. Toshmatov N.U. Issiqlik va gaz ta'minoti tizimlari [Heat and Gas Supply Systems]. Textbook. – Tashkent, 2021. – 94 p. 3. Saydullayev S. Issiqlik ta'minoti tizimlari [Heat Supply Systems]. Study guide. – 2023. – 130 p. 4. Tursunov M. Issiqlik ta'minoti tizimlari [Heat Supply Systems]. Study guide. – 2023. – 122 p. 5. Meliyev B., Musayev Sh. Issiqlik va gaz ta'minoti [Heat and Gas Supply]. Study guide. – 2021. – 123 p. **Additional literature:** 6. Nurmatov J., Xalilov N.A., Tolipov U.K. Issiqlik texnikasi [Heat Engineering]. Study guide. – Tashkent: O'qituvchi, 1998. – 35 p. 7. Madaliyev E.O'. Issiqlik texnikasi [Heat Engineering]. Textbook for higher education institutions. – Fergana: Farg'ona, 2001. – 32 p. 8. Zohidov R.A., Alimova M.M., Mavjudova Sh.S. Issiqlik texnikasi [Heat Engineering]. Textbook. – Tashkent: O'zbekiston faylasuflari milliy jamiyati, 2010. – 40 p. 9. Xudoyberdiyev T.S., Shaymardanov B.P., Usmonov K.E. Issiqlik texnikasi fanidan masalalar to'plami [Collection of Problems in Heat Engineering]. Study guide. – Tashkent: TIIAME, 2015. – 46 p. 10. Луканин В.Н., Шатров М.Г., Камфер Г.М. и др. Теплотехника [Lukanin V.N., Shatrov M.G., Kamfer G.M. et al. Heat Engineering]. Textbook for universities / ed. V.N. Lukanin. 2nd ed., revised. – Moscow: Vysshaya shkola, 2000. – 37 p. **Internet resources** 11. www.gov.uz – Government portal of the Republic of Uzbekistan. 12. www.lex.uz – National database of legislation of the Republic of Uzbekistan. 13. www.ziyonet.uz – Information and educational network of the Republic of Uzbekistan. 14. http://www.GES.ru

	15. http://www.nasos.ru 16. http://www.energ.narod.ru