Name of subject	Methodology of scientific research (ECTS 4)
Subject/module code	ITM1104
Science taught semester (s).	1st semester
Responsible teacher	Yuldashev Urishbay, professor
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-120** **Audience Training hours – 36** Lecture training hour – 18 Practical training hour – 18 **Independent education -84 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** It is the study and application of methods and approaches used to obtain scientific knowledge in a consistent, accurate, and well-founded manner. That is, through this methodology, the researcher determines how to approach the scientific problem he has set himself, what data to collect, how to analyze them, and how to base conclusions on them. **The objective of the course** It aims to study the current state of the energy system, introduce the specific features of the main enterprises and organizations that are part of the country's energy system, teach various methods of generating electricity. In addition, it provides theoretical knowledge and develops practical skills in the transmission, distribution and use of electricity. Learning Outcomes: 1. The Scientific Research Methodology course explores the role of science in production; 2. Science algorithm, object, task, model representation, experiment and its execution; 3. Stages of conducting research, analysis, synthesis, correction, presentation of results and recommendations for production; 4. Selecting objects, model classes, and functions; 5. Manifestations of task resources, sequence in task expression; 6. Scientific and technical information, level of information (color), generalization of knowledge, methods of information acquisition; 7. Standard indicators of measuring devices. Histogram; 8. Determining random error, probability distribution, methods for obtaining the exact value.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: 1. Fundamentals of scientific research. 2. Preparing for scientific research. 3. The content and implementation methods of the research stages. 4. The content and implementation methods of the research stages. 5. Analysis of the stages of scientific research. Selection of object, model and task. 6. Planning, conducting experiments, and analyzing the results obtained. 7. Planning, conducting experiments, and analyzing the results. 8. Fundamentals of experimental design. 9. Preparing and conducting an active experiment. **II. Instructions and recommendations for organizing laboratory exercises.** Laboratory work is not included in the curriculum

	III. Practical training instructions and recommendations The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform.Methodological guidelines serve as the primary instructional document for instructors in preparing and conducting practical sessions. The purpose of the practical session is to facilitate the comprehension of theoretical material, the acquisition of practical skills, the ability to consciously apply knowledge in academic and professional activities, and the development of critical thinking and confidence in forming personal viewpoints. *Recommended Practical Topics:* 1. Choosing a topic, checking the requirements for the topic. 2. Study of scientific and technical literature and information, expressing the purpose, objectives, object and subject of research. 3. Methodological foundations of scientific knowledge 4. Choosing a direction for scientific research. Formulating a scientific and technical problem. Stages and levels of scientific research.. 5. Formulating a scientific and technical problem. Stages and levels of scientific research.. 6. Stages and levels of scientific research work. 7. Classification of scientific research. 8. Empirical level of scientific research 9. Scientific progress and their level (color) **IIV. Independent learning and practical exercises** Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form. Recommended topics for practical exercises: 1. The concept of modeling and its definition. 2. Procedure for conducting experimental research. 3. Conducting a production experiment. 4. Key recommendations for collecting information. 5. What is active experimentation and how to do it. 6. Scientific methodological foundations. 7. Explain the mathematical model of a two-factor process.
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. Shermuhammedova H. A., Ilmiy tadqiqot metodologiyasi. Darslik.-T "Fan va texnologiya" 2014.-512b 2. Mirzayev F.P. Ilmiy tadqiqot metodologiyasi. Darslik.-T. 3. Грищук Ю.С., Жилинский В.В. Основы научных исследований и инновационной деятельности.-Минск: БГТУ, 2016.-143. 4. Блинов Ю.И., Васильев А.С., Никаноров А.Н. я доктор. Современные энергосберегающие электротехнологии. Учебное пособие. Издательство СПбГЭТУ «ЛЭТИ», 2001. – 564 с. 5. David V. Thiel Research Methods for Engineers Cambridge University Press 2014 6. Neville A. Engineering Research: Design, Methods, and Application 2007 7. T.M.Letcher Future Energy: Improved, Sustainable and Clean Options for Our Planet Elsevier 2020. 8. J.W.Creswell Research Design: Qualitative, Quantitative, and Mixed Methods Approaches SAGE Publications 2018 **Additional literature:** 9. Mirziyov 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 yil 16 yanvar, №11. 10. Mirziyoyev Sh.M. Erkin va farovon, demokratik O'zbekiston davlatini birgalikda barpo etamiz. O'zbekiston Respublikasi Prezidentining lavozimiga kirishish tantanali marosimiga bag'ishlangan Oliy Majlis palatalarining qo'shma majlisidagi nutqi. –T.: "O'zbekiston" NMIU, 2016. – 56 b. 11. Mirziyoyev Sh.M. Buyuk kelajagimizni mard va olijanob xalqimiz bilan birga quramiz. - T.: "O'zbekiston" NMIU, 2017. – 488 b. 12. The Beginne's Guide to Engineering: Mechanical Engineering, 2013 by Mark Huber. 13. The Electric Power Engineering Handbook, Third Edition - Five Volume Set (Electrical Engineering Handbook), 2012 by Leonard L. Grigsby. 14. Кадиров А.А., Хамудханов М.М. Методы исследования и расчета энерго- ресурсосберегающих режимов работы водоподъемных насосных станций. -Т: «Янги аср авлоди», 2013. - 120 с. 15. Сипайлов Г.А., Лоос А.В. Математическое моделирование электрических машин. - М.: Высшая школа, 1980. - 176 с. **Internet sites:** 16. www.gov.uz –Government portal of the Republic of Uzbekistan. 17. www.catback.ru – international scientific articles and educational materials website. 18. www.google.ru – international educational materials search website. 19. www.ziyonet.uz – national educational materials search website. 20. www.lex.uz – national database of legal documents and

	information. 21. www.catback.ru – scientific articles and educational materials

Name of subject	**Methodology of teaching special subjects (ECTS 8)**
Subject/module code	MFO‘M1304
Science taught semester (s).	3rd semester
Responsible teacher	Mustafakulov Asatulla Asrorovich, PhD., associate professor.
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-120** **Audience Training hours – 36** Lecture training hour – 18 Practical training hour – 18 **Independent education -84 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject** - the purpose of this subject is to acquaint undergraduates with the methodology, methodology, theoretical and practical foundations of teaching special subjects in the higher education system, modern pedagogical and psychological knowledge necessary for their future pedagogical and research activities, including; - state education standards and model science programs developed based on them, the procedure for developing curricula; - ability to choose the optimal strategy for teaching special subjects, develop and implement modern educational technologies; - to develop the skills of using innovations in the field of scientific research and education in improving the teaching methodology of special subjects. **The task of the subject -** is to improve the pedagogical skills of master's students in teaching special subjects, to introduce them to modern methods of organizing practical and theoretical classes, to analyze educational and methodological materials for special subjects, to develop and implement various methods of classes. transfer, as well as teach modern ways of monitoring and evaluating students' knowledge level. **Learning outcomes:** In the process of mastering the subject “Methodology of teaching special subjects”, the master's student: - the purpose, mission and subject of science; - about regulatory and legal documents of higher education, State educational standard, qualification requirements, classification of specialties, curriculum, model and working curriculum, curriculum, model and working curricula must have knowledge skills; - to have an idea and knowledge about the nature and problems of pedagogical activities in the higher education system; - should have an idea about achievements and problems in teaching special subjects, modern methods of modeling pedagogical activity, and integration of the Republic of Uzbekistan into the world education system. In the educational process, it is necessary to be able to apply the fundamental foundations of knowledge, the achievements of science, the connection of the taught science with other sciences, to know the main problems and achievements of the science, and to have the skills to divide science topics into modules;

	Using the results of scientific research in the teaching of special subjects, conducting educational-methodical and scientific work in higher education - choosing educational materials suitable for the audience, creating assignments, exercises and tests on topics, educational and educational systematization of work, as well as giving oral and written explanations in the teaching of special subjects, effective use of educational technologies, computer equipment and information technologies appropriate to the subject in classes, students' independent learning skills and their professional and creative skills should have the skills to handle oneself in various situations related to development, pedagogic activity.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** **Topic 1:** The content, subject and purpose of the teaching methodology of special subjects. **Topic 2:** Regulatory and legal documents of higher education. **Topic 3:** Organizational forms of teaching special subjects. **Topic 4:** Teaching methods and the main criteria for their selection. **Topic 5:** The necessity and role of demonstration, technical and information support in the teaching of special subjects. **Topic 6:** The role, types, and application methods of teaching tools in the teaching of special subjects. **Topic 7:** The lecture is the main link of the educational process. Functions and types of lectures. **Topic 8**. Practical training and seminar classes. **Topic 9:** Organization of independent education in the study of special subjects. **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. The content, subject and purpose of the subject of teaching methodology of special subjects. 2. Regulatory and legal documents of higher education. 3. Organizational forms of teaching special subjects. 4. Teaching methods and the main criteria for their selection. 5. The necessity and role of demonstration, technical and information support in the teaching of special subjects. 6. The role, types, and application methods of teaching tools in the teaching of special subjects. 7. The lecture is the main link of the educational process. The lecture functions and types. 8. Practical training and seminar classes.

	9. Organization of independent education in the study of special subjects. 10. Creative forms of independent research. 11. Organization and conduct of educational practice in special subjects. 12. Organization of the educational process, application of world practice in testing and evaluating student knowledge. **III. Coursework instructions and recommendations** The following topics are recommended for the course project: 1. Design of the power transmission scheme of the hydroelectric power plant. 2. Design of the power transmission scheme of the thermal power plant. 3. Design of the power transmission scheme of the thermal power center. **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. Classification of pedagogical technologies; 2. Methodological principles of pedagogical technology research; 3. Module-based training programs and their structure; 4. Main features of modern pedagogical technologies; 5. Modern interactive technologies and methods of their effective use; 6. Distinctive features of distance education in the Republic of Uzbekistan; 7. The main tasks of the lecture training, the main methodical aspects of the preparation of the lecture; 8. Professional-pedagogical culture; 9. Designing and implementing the educational process using multimedia tools; 10. Professional skills of a modern pedagogue; 11. Specific features of teaching special subjects; 12. Methods and technologies of effective organization of practical training; 13. Pedagogical ability in the teacher's work; 14. Teacher's communicative ability; 15. Communication culture and psychology in teacher's work; 16. Pedagogical conflicts and their prevention technology; 17. Interaction between teacher and students; 18. Teacher's skills in the educational process;
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. Xoliqov A. Pedagogik mahorat. –T.:Iqtisod-moliya nashriyoti, 2010.-420b.
2. Muslimov N. F, Qo‘ysinov O.A. Kasb ta’limi o‘qituvchilarini tayyorlashda mustaqil ta’limni tashkil etishning nazariyasi va metodikasi. Monografiya. T.: Fan, 2009.
3. N.Muslimov, M.Usmonboyeva, D.Sayfurov,A.To`rayev, Innovasion ta`lim texnologiyalari T.:2015. 208 b.
4. Q.T.Olimov, F.H.G‘afforov.D.A. Sayfullayeva, A.Yu. Isakov, O.E.Azizov. Innovatsion ta’lim texnologiyalari. –T.: « LESSON PRESS »,2021, 280 bet.
5. N.S.Sayidahmedov, N.N. Indaminov, Pedagogik mahorat va pedagogik texnologiya, T: 2014.
6. Xoliqov A.A. Pedagogik mahorat. Darslik. – T.: “Tafakkur bo‘stoni”, 2011.
7. Xujaev N, Tojiboeva D. Maxsus fanlarni o‘qitish uslubiyati. O’quv qo’llanma - T.: Fan, 2009.
8. Xujaev N. , SHomurotova N. Maxsus fanlarni o‘qitish uslubiyati. O’quv qo’llanma - T.: Fan, 2012.
9. Tojiboeva D. Maxsus fanlarni o‘qitish metodikasi . O’quv qo’llanma - T.: FAN VA TEHNOLOGIYA, 2007. 541b.Internet saytlari:

Additional literature

1. Бондаревская Е.В. Теория и практика личностно ориентированного образования. – Ростов-на-Дону: РГПУ, 2000.
2. Ochilov M., Ochilova N. O‘qituvchi odobi. – T.: O‘qituvchi, 1997.
3. Подласый И. П. Педагогика. – М.: ВЛАДОС, 2010.
4. Muhiddinov.A.G. O‘quv jarayonida nutq faoliyati. – T.: O‘qituvchi, 1995.
5. Ochilov M. Muallim qalb me`mori. – T.: O‘qituvchi, 2000.
6. Ma'naviyat darslari (Tuzuvchi S. Nishonova). – T.: O‘qituvchi, 1994.
7. O‘zbek pedagogikasi antologiyasi. T.: O‘qituvchi, 1995.
8. Muhiddinov A.G. O‘quv jarayonida nutq faoliyati. – T.: O‘qituvchi, 1995.
9. Mahmudov N. M. O‘qituvchi nutq madaniyati. Darslik. – T.: O‘zbekiston milliy kutubxonasi, 2007.

Information sources

1. www. tdpu. uz
2. www. pedagog. uz
3. www. Ziyonet. uz

	4. www. edu. uz 5. tdpu-INTRANET. Ped

Name of subject	Scientific basis of using alternative energy sources (ECTS 10)
Subject/module code	MEMFIA11210
Science taught semester (s).	1st and 2nd semesters
Responsible teacher	Nazarov Furkat, PhD., senior teacher
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-300** **Audience Training hours – 90** Lecture training hour – 46 Practical training hour – 44 **Independent education -210 hours**
ECTS	10
The purpose and tasks of subject / learning outcomes	The purpose of teaching the subject "Scientific basis of using alternative energy sources" is to teach master's students about the rational use of energy, the regulation of consumption by energy forms, the management of scientific basis of using alternative energy sources, the fundamental essence of the policy on the use of alternative energy sources, and energy is to form the skills of practical implementation of saving measures. The task of the subject are to acquire information about alternative energy sources, to study their structure, devices, working processes and technical and economic justification. Learning Outcomes: 1. Acquaintance with the basics of solar heat supply systems based on modern types, methods and programs; 2. Role of Scientific basis of using alternative energy sources in society and socio-economic importance; 3. Acquaintance with alternative energy sources. 4. Study of alternative energy sources using modern computer programs; 5. Studying the technical and economic indicators of alternative energy devices, their place in ecology and the principles of use; 6. Increasing the efficiency of alternative energy sources equipment; 7. Economic assessment of the competitiveness of traditional and non-traditional methods of heat energy production; 8. To know and be able to use the existing main legal and regulatory documents in the field.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: 1. Renewable energy sources of Uzbekistan. 2. Environmental impact of traditional energy. 3. Production of electricity from solar energy. 4. Photoelectric properties of p-n junction. 5. Solar panels and their structure. 6. Solar power plants. 7. Solar energy converters. 8. Solar concentrators. 9. Steam turbine solar power plants. 10. Accumulation of energy into heat. 11. Renewable energy sources of the oceans 12. Flow power plants. 13. The physical basis of the emergence of wind energy. 14. Wind energy devices and their structure. 15. Wind power plants and their types.

16. Methods of coordinating electricity consumers with wind energy devices.
17. The concept of an ideal windmill. A real windmill theory.
18. Hydraulic energy and its sources.
19. Hydroelectric power plants and their types.
20. Production of biogas from agricultural waste.
21. Biogases. Boiler devices for burning biofuels.
22. Bioenergy. Bioenergetic devices and their structure.
23. Geothermal energy sources. Single circuit geothermal power plants.

II. Instructions and recommendations for organizing laboratory exercises.

Laboratory work is not included in the curriculum

III. Practical training instructions and recommendations

The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform.Methodological guidelines serve as the primary instructional document for instructors in preparing and conducting practical sessions. The purpose of the practical session is to facilitate the comprehension of theoretical material, the acquisition of practical skills, the ability to consciously apply knowledge in academic and professional activities, and the development of critical thinking and confidence in forming personal viewpoints.

Recommended Practical Topics:

1. Study of the device of the solar module.
2. Study of the electrophysical characteristics of the battery of solar cells.
3. Study of the electrophysical properties of the battery of solar cells.
4. Calculation of flat parabolic concentrator solar power plants.
5. Sensing the statistical characteristics of wind flow.
6. Calculation of wind energy device parameters and air flow.
7. Studying the system connection scheme of the wind energy device.
8. Studying the method of determining geothermal resources.
9. Calculation of a single-circuit hetermal power plant.
10. Calculation of parameters of biogas plants.
11. Determination of technical economic, energetic and environmental efficiency of energy devices based on alternative and renewable energy sources.

IV. Independent learning and practical exercises

Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form.

Recommended topics for practical exercises:

1. Renewable energy sources of Uzbekistan
2. Environmental impact of traditional energy
3. Production of electricity from solar energy
4. Photoelectric properties of p-n junction
5. Solar panels and their structure
6. Solar power plants
7. Solar energy converters
8. Solar concentrators
9. Steam turbine solar power plants

	10. Accumulation of energy into heat 11. Renewable energy sources of the oceans 12. Flow power plants 13. Physical foundations of the appearance of wind Energy 14. Wind energy devices and their structure 15. Wind farms and their types 16. Study of the device of the solar module 17. Study of electrophysical xoccas of solar element battery 18. Calculation of solar power plants with flat parabolic concentrators 19. Sensing the statistical characteristics of wind flow 20. Methods of coordinating electricity consumers with wind energy devices 21. The concept of an ideal windmill. The theory of a real windmill 22. Hydraulic energy and its sources 23. Hydroelectric power plants and their types 24. Production of biogas from agricultural waste 25. Biogases. Boiler devices for burning biofuels 26. Bioenergy. Bioenergetic devices and their structure 27. Geothermal energy sources. Single circuit geothermal power plants 28. Calculation of wind energy device parameters and air flow 29. Studying the system connection scheme of the wind energy device 30. Studying the method of determining geothermal resources 31. Calculation of a single-circuit hetermal power plant 32. Determining the technical economic, energetic and ecological efficiency of energy devices based on alternative and renewable energy sources.
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. Tvidell J.V. Wier A.D.,Renewable Energy Resources,London.2015.

2. Gemma Ijerranz,Gloria P.Rodrnguez.Use4s of Concentrated Solar Energy in Materials Sciense-Spain: INTEC14,2010.ISL3N 978-913-307-052-0

	3. S.A.Nikonov, A.A.Goryayev, S.V.Petuxov, N.B.Bajnitseva, Butakov S.V. Нетрадиционные источники енергии агропромышленном комплексе. Методические указания для практических занятий. Новосибирск 2018. 4. Ellaban Omar, Abu-Rubb Haityitham, Blaabjerk Frode.Renevable energy resources “Current status future prospekts and their enabling texnology” Renevable and Sustainable Energiy Revievs 2014. 5. Majidov T. Noan’anaviy va qayta tiklanuvchi energiya manbalari-T.”Voris nashryoti”,2014. 6. Klsichev Sh.I.Muxammadiyev M.M. Avezov R.R.Нетрадиционные и взобнавляемые источники энергии.Учебник-Т.”Фан ва технология» 2010. **Additional literature:** 1. On the strategy of actions for the further development of the Republic of Uzbekistan - Decree No. PF-4947 of February 7, 2017. 2. Law of the Republic of Uzbekistan "On rational use of energy". 2019. 3. Nioola Armaroti. Energy for a Sustainable World-From the oil Age to a Sun-Povered Future.Wiley-VCH 2011. 4. Global Trends in Renevable Energy Investment 2016.Franakfurt Shool-IN.j 5. Аллаев К.Р., Электроэнергетика Узбекистана и мира. -Т.: «Фан ва технология», 2009. **Internet sites:** http://www.universalintemetlibrary.ru/# http://www.energo-resurs.ru/vzh_tezis_2004.htm www.ime.ru www.mpei.ru www.abok.ru http://www.universalinternetlibrary.rU/#

Name of subject	Energy Systems and Equipment for the Utilization of Solar Energy (ECTS 12)
Subject/module code	QEFETQE12312
Science taught semester (s).	2nd and 3rd semesters
Responsible teacher	Anarboev Mukhiddin Almanovich, PhD., associate professor.
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-360** **Audience Training hours – 108** Lecture training hour – 54 Practical training hour – 54 **Independent education -252 hours**
ECTS	12
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** that currently, the issues of widespread use of non-traditional and renewable energy sources are being widely discussed all over the world. In order to develop these works, the task of training qualified basic personnel - masters is set in the conditions of the Republic of Uzbekistan. To achieve this goal, students of the subject are required to acquire theoretical fundamental knowledge and practical skills, knowledge of solar energy devices and the history of their development. The requirements are to study the technical potential of solar energy resources, study the basics of using energy devices, investigate alternative energy sources, participate in roundtable discussions with scientists in the field, and participate in scientific seminars. The main purpose of teaching this subject is to provide students with the necessary knowledge about the use of the technical potential of solar energy in our country, as well as the technical and economic indicators of devices, their role in ecology and principles of use, as well as the skills to adopt correct solutions to technical problems, and broaden their worldview. **The objective of the course** "Energy Systems and Devices for Using Solar Energy" is designed to prepare future specialists in the field of solar energy utilization, with a focus on technical, economic, and ecological aspects. The primary objective is to provide students with comprehensive theoretical knowledge and practical competencies required to analyze, design, install, and operate solar energy systems relevant to Uzbekistan's conditions and global technological trends. Students will acquire fundamental understanding of solar radiation physics, solar resource evaluation methods, and the structure and operation of various solar energy devices including photovoltaic panels, solar collectors, solar pools, and tower systems. The course emphasizes skills in calculating solar energy potential, evaluating device performance, and optimizing system orientation and efficiency. The course also introduces students to physical mechanisms of photovoltaics, concentrators, and photoelectric converters. It develops their ability to analyze technical-economic indicators, assess the feasibility of solar energy projects, and explore the interaction between solar technology and ecological sustainability.Additionally, the program fosters academic engagement through scientific seminars and discussions with experts in the field, enhancing students' ability to adopt informed, responsible, and technically sound decisions in the energy sector.

	Learning Outcomes: 1. Have a clear idea and knowledge of the role of the power supply system in the energy system, saving electricity, and its proper distribution to consumers; 2. Know the basic concepts of the field and their essence, initial information on the design of consumer power supply systems, as well as the specific features of the use of traditional and non-traditional energy sources and have the skills to use them; 3. Must be able to study and analyze existing problems in the field of uninterrupted and high-quality heat and energy supply to consumers and adopt initial solutions to these problems.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: 1. Introduction to the science of ‘‘Energy systems and devices for using solar energy’’ and its role in energy networks. 2. Earth. Sun and planets. Sources of solar radiation and its uniqueness. Basic concepts and quantities. 3. Earth, Sun and planets. Sources of solar radiation and its characteristics. Basic concepts and quantities. 4. The influence of the main and additional factors on the incidence of solar radiation on an arbitrary oriented receiving field at point A in the Universe and on the Earth. 5. The influence of the main and additional factors on the incidence of solar radiation on an arbitrary oriented receiving area at point A in space and on the Earth. 6. Calculation of the flux density of solar radiation incident directly on an arbitrary inclined receiving area. 7. Operation of a solar power plant as part of a large integrated energy system. 8. Software requiring initial data. 9. Solar energy cadastre and its characteristics. 10.Methods for calculating gross resources for a horizontal receiving area in a given Skm2 area at point A based on complete information. 11.Methods for calculating the total resources for a horizontal receiving area at point A and a given Skm2 area based on a limited set of initial data for an average daily or monthly calculation interval 12.Methods for calculating the total resources for a south-facing receiving area at point A and a given Skm2 area for an average daily or monthly calculation interval. 13.Methods for calculating the average amount of sunlight falling on arbitrarily oriented receiving area. 14.Optimization of the orientation of the receiving site observing the azimuth and inclination angle of the sun. 15.Methodological approach to the calculation of ecological, economic and technical-ecological resources at point A and for a given area S km2. 16.Angstrom method for calculating solar radiation resources. Technical-ecological calculation of the solar radiation potential. Ecological-economic calculation of the solar radiation potential and its specific aspects. The influence of types of QEQ on the technical-ecological potential of solar radiation. 17.Devices designed to measure the solar radiation flux density. 18.Classification of solar energy devices and their characteristics. 19.Solar energy devices for public utilities. 20.Tower solar power plants and their energy characteristics. 21.Solar pools and their energy properties. 22.Physical mechanisms of direct conversion of solar energy into electricity.

23.Concentrators for concentrating sunlight and their properties.
24.Physical foundations of photovoltaics.
25.Classification, construction and principles of operation of photoelectric converters.
26.Study of the properties of the constituent structures of photovoltaic converters.
27.Solar photovoltaic devices, systems and their design.
28.Energy characteristics of solar photovoltaic devices.
29.Autonomous solar photovoltaic devices.
30.Photovoltaic plants operating in parallel with the local power grid.
31.Passive and active solar water heater systems.

II. Instructions and recommendations for organizing laboratory exercises.

Laboratory work is not included in the curriculum

III. Practical training instructions and recommendations

The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform.Methodological guidelines serve as the primary instructional document for instructors in preparing and conducting practical sessions. The purpose of the practical session is to facilitate the comprehension of theoretical material, the acquisition of practical skills, the ability to consciously apply knowledge in academic and professional activities, and the development of critical thinking and confidence in forming personal viewpoints.

Recommended Practical Topics:

1. Review of laws and regulatory documents adopted by the Republic of Uzbekistan in the field of solar energy.
2. Study of the parameters of radiation occurring on the Earth and the Sun.
3. Review of issues related to the influence of main and additional factors on solar radiation falling on an arbitrarily oriented receiving area at point A under terrestrial conditions.
4. Review of issues related to the influence of main and additional factors on solar radiation falling on an arbitrarily oriented receiving area at point A under terrestrial conditions.
5. Study of methods for calculating the flux density of solar radiation falling directly on an arbitrarily inclined receiving area.
6. Review of the cadastre of solar energy and its characteristics.
7. Study of methods for calculating solar energy resources.
8. Consideration of the calculation of the total energy resources for the horizontal receiving area at point A and in a given Skm2 area based on complete information.
9. Methods for calculating the total energy resources for the horizontal receiving area at point A and in a given Skm2 area based on a limited set of initial data for an average daily or monthly calculation interval.
10. Methods for calculating the total energy resources for the horizontal receiving area at point A and in a given Skmw2 area based on a limited set of initial data for an average daily and monthly calculation interval.
11. Consideration of the calculation of the average amount of sunlight falling on an arbitrarily oriented receiving area.
12. Calculation of the orientation of the observing receiving area by the azimuth and inclination angle of the sun.

	13.Testing in practice equipment designed to measure the solar radiation flux density. 14.Study of the main technical schemes for the use of solar energy on Earth and their energy performance. 15.Classification of solar energy devices and their characteristics 16.Evaluation of the parameters of solar energy devices intended for public utilities. 17.Consideration of tower solar power plants and their energy characteristics. 18.Study of solar pools and their energy characteristics 19.Observation of electronic devices that directly convert solar energy into electrical energy in operation. 20.Consideration of solar concentrators and their characteristics. 21.Calculation of solar photovoltaic devices and their technical and energy indicators. 22.Study of the physical mechanisms of photovoltaics. 23.Irrational use. **IIV. Independent learning and practical exercises** Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form. Recommended topics for practical exercises: **2nd Semester** 1. Issues of Using Renewable Energy Sources 2. Desalination of Water and Air Cooling Using Solar Energy 3. Biological, Chemical, and Mechanical Methods of Energy Storage 4. Methods of Biomass Processing **3rd Semester** 5. Types of Energy Obtained from Biomass Processing 6. Global Development of Biogas Technologies and Factors Affecting Biogas Production 7. Solar Photovoltaic Devices and Calculation of Their Technical-Energy Parameters 8. Study of Physical Mechanisms in Photovoltaics
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. Twidell J.W., Wier A.D. Renewable Energy Resources. London, 2015.
	2. Gemma Herranz, Gloria P.Rodrnguez. Uses of Concentrated Solar Energy in Materials Science.-Spain; INTECH, 2010. ISBN 978-953-307-052-0
	3. S.A.Nikonov, A.A Goryayev, S.V Petuxov, N.B. Balanseva, S.V Butakuv. Netraditsionnie istochniki energii v agropromishlennom komplekse. Metodicheskiye ukazaniya dlya provedenya prakticheskix zanyatiy. Novosibrsk-2018.
	4. Ellabban Omar, Abu-Rub Haitham, Blaabjerg Frede. Renewable energy resources; Current status, future prospects and their enabling technology. Renewable and Sustainable Energy Reviews, 2014.
	5. Majidov I. Noan'anaviy va qayta tiklanuvchi energiya manbalari-T.. Vopris nashryoti-2014.
	6. Kichev SH.I., Muxammadiyev M.M., Avezov R.R., Potoyenko K.D. Nyetraditsionnie I vzobnovlyayemi istochniki energii. Uchebnik. T.. Izd-vo Fan va texnologiya-2010.
	7. Muxammadiyev M.M., Tashmatov X.K. Energiya yig'uvchi qurilmalari. Darslik.-T.. Yangi nashr-2010.
	8. Baxadirxanov M.K., Kobilin G.O., Tachilin S.A., Fizika I texnologiya solnechnix elementov. Ch.1.2.-T.. TGTU-2007.
	Additional literature:
	9. O'zbekistonda qayta tiklanadigan energetikani rivojlantirish istiqbollari. BMT Taraqqiyot dasturi.-T., 2007y.
	10. Nicola Armaroli, Vincenzo Balzani. Energy for a Sustainable Word-Form the Oil Age to a Sun-Powerd Future. Wiley-VCH 2011. ISBN 978-3-527-32540-5.
	11. Lovins, Amory, Reinventing Fire; Bold Business Solutions for the New Energy Era. Chelsea Green Publishing, 2011.
	12. Volker Quaschning. Understanding Renewable Energy System. Warthscan, London, 2016. ISBN 978-113878-196-2.
	13. Global Trends in Renewable Energy Investment 2016. Frankfurt School-UNEP Center/BNEF. 2016. http;//www.fs-unep-center.org..
	14. Word Energy Council. For sustainable energy. Copyright 2013 World Energy Council, London, www.worldenergy.org. ISBN; 978-0-946121-29-8.
	15. Vissarionov V.I., Deryugina G.V., Kuznetsova V.A., Malinin N.K., Solnechnaya energetika. Uchebnoye posobiye dlya vuzov.-M; Izdatelskiy dom MEI, 2008.
	16. Kukutin B.V. Vozobnovlyayemie istochniki elektroenergii. Uchebnoye posobiye.- Tomsk; Izd. Tomskogo politexnicheskogo universiteta, 2008.
	17. Muxammadiev M.M., Urishev B.U., Djuraev K.S., Gidroenergetik qurilmalar. Darslik.- Toshkent; Fan va texnologiya-2015.
	Internet sites:
	18. www.gov.uz –Government portal of the Republic of Uzbekistan.
	19. www.catback.ru – international scientific articles and educational materials website.
	20. www.google.ru – international educational materials search website.
	21. www.ziyonet.uz – national educational materials search website.
	22. www.lex.uz – national database of legal documents and information.

	23. www.catback.ru – scientific articles and educational materials

Name of subject	**Preparation for Operation and Design of Installation of Energy Systems Based on Alternative Energy Sources (ECTS 10)**
Subject/module code	MEMAEQO‘LFT12306
Science taught semester (s).	2nd and 3rd semesters
Responsible teacher	Anarboev Mukhiddin Almanovich, PhD., associate professor.
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-300** **Audience Training hours – 90** Lecture training hour – 46 Practical training hour – 44 **Independent education -210 hours**
ECTS	10
The purpose and tasks of subject / learning outcomes	**The purpose of this course** is to provide students with comprehensive theoretical and practical knowledge required for the planning, installation, and commissioning of energy systems based on alternative energy sources. The course covers a wide range of topics including the classification and reserves of renewable energy sources, principles of thermal and electrical energy generation and utilization, and the technical foundations for the deployment of alternative energy technologies. Students will study the structure and operating principles of devices powered by alternative sources, such as solar energy systems, heat pumps, low-potential energy sources, wind turbines, biogas plants, and geothermal units. The course emphasizes the practical applications of renewable energy systems, focusing on system design, energy accumulation and storage, hybrid operation of conventional and non-conventional sources, and the future prospects of the renewable energy sector. By completing this course, students will be able to develop and evaluate engineering solutions for the integration of renewable energy systems, optimize their performance, and assess their technical and economic viability for use in Uzbekistan’s energy infrastructure. They will also gain awareness of ecological implications and the global shift toward sustainable energy development. **The objective of the course** *“Designing, Installation and Operational Readiness of Energy Systems Based on Alternative Energy Sources”* is to prepare future specialists in the field of renewable energy, focusing on the planning, installation, and commissioning of systems powered by alternative energy sources. Students will acquire comprehensive theoretical knowledge and practical skills related to system design, energy conversion, and integration. The course also covers the structure, operation, and technical characteristics of solar, wind, geothermal, biomass, and hydrogen-based devices. It emphasizes performance analysis, environmental and economic assessment, and system optimization. Additionally, students will participate in seminars and discussions with field experts, enabling them to make responsible, well-informed engineering decisions. **Learning Outcomes:** 1. To acquire knowledge about the planning, installation, and commissioning of energy devices based on alternative energy sources. 2. To study the structure, operating principles, and fundamental concepts of utilizing adapted energy systems. 3. To explore the global development and implementation

	processes of unconventional and renewable energy technologies (URETs). 4. To understand the methods of converting natural and secondary energy sources into thermal and electrical energy. 5. To develop skills in calculating according to assessment parameters of unconventional and renewable energy sources. 6. To build competence in drawing principle circuit diagrams of renewable energy system devices. 7. To develop the ability to determine the extractable power of devices based on renewable energy technologies through calculations and to operate such systems effectively. 8. To assess the feasibility of using renewable energy technologies in the natural conditions of the Republic of Uzbekistan.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: **2nd semester** 1. Introduction to the course "Planning, Installation and Operational Readiness of Energy Systems Based on Alternative Energy Sources." Basic concepts, terms, and quantities 2. Power supply for decentralized consumers 3. Construction of photovoltaic batteries 4. Electrical safety requirements for photovoltaic batteries 5. Requirements for components of photovoltaic systems 6. Charge-discharge controllers and inverters in photovoltaic systems 7. Replacement, maintenance, and acceptance of devices in decentralized power supply systems 8. Designing a hot water supply system for a household providing 400–600 liters per day **3rd semester** 9. Designing the use of combined solar heating systems and individual boilers for residential heating 10. Planning the construction of a tower-type solar power plant: site selection and analysis of solar tracking systems for heliostats 11. Manufacturing and designing a parabolic-cylindrical type solar thermal power plant 12. Designing wind energy system installations and stations 13. Designing heat pump devices 14. Designing and installing biogas energy systems 15. Developing and designing small and micro hydropower plants **II. Instructions and recommendations for organizing laboratory exercises.** Laboratory work is not included in the curriculum **III. Practical training instructions and recommendations** The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform. Recommended Practical Topics: **2nd semester** 1. Analysis of parameters, characteristics, energy indicators, and other data of energy devices based on alternative and renewable energy sources 2. Study and analysis of power supply issues for decentralized consumers

	3. Design and technical requirements for photovoltaic batteries 4. Electrical safety standards and usage procedures for photovoltaic power stations 5. Requirements and usage procedures for photovoltaic station components 6. Charge-discharge controllers and inverters in photovoltaic systems and design-based calculation tasks 7. Inspection and technical maintenance of decentralized power supply system devices 8. Design calculations for hot water supply systems (400–600 liters/day) for facilities **3rd semester** 9. Design calculations for combined heliosystems and individual gas boilers in heating systems 10. Design calculations for tower-type solar thermal power plants 11. Simulation of the design process of a parabolic-cylindrical type solar thermal power station 12. Design procedures for wind energy systems and stations 13. Design methods for heat pump systems 14. Design and installation of biogas systems and small/micro hydropower plants 15. Study of methods for identifying geothermal resources 16. Design of geothermal systems for heat supply 17. Calculation of dual-circuit geothermal power plants 18. Calculation of single-circuit geothermal power plants 19. Efficiency calculation of hydrogen-oxygen fuel cells 20. Study of electrophysical properties of solar cell batteries 21. Calculation of solar power stations with flat parabolic concentrators **IV. Independent learning and practical exercises** Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form. Recommended topics for practical exercises: **2nd Semester** 1. Challenges in the Utilization of Renewable Energy Sources 2. Desalination of Water and Air Cooling Using Solar Energy 3. Biological, Chemical, and Mechanical Methods of Energy Storage 4. Efficiency Calculation of Hydrogen-Oxygen Fuel Cells 5. Electrical Safety Requirements and Usage Procedures of Photovoltaic Power Stationss 6. Inspection and Technical Maintenance of Decentralized Power Supply Systems **3rd Semester** 7. Methods for Processing Biomass 8. Types of Energy Obtained from Biomass Processing 9. Global Development of Biogas Technologies and Factors Influencing Biogas Production 10. Design and Installation Processes for Biogas Systems and Small/Micro Hydropower Plants 11. Study of the Electrophysical Properties of Solar Cell Batteries.
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:

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7. Постановление Кабинета Министров РУз №164 «Правила проведения энергетичемского аудита и энергетических экспертиз потребителей ТЭР». 07.08.2006 г.
8. Постановление Кабинета Министров Республики Узбекистан № 13 «О мерах по разработке концепции реформирования системы теплоснабжения и программы модернизации и развития системы теплоснабжения в республике на период 2009-2015 годы» 2009 г.
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11. КМК 2.08.04-04 Нормативы расхода энергии на отопление, вентиляцию и кондиционирование зданий и сооружений. Госкомархитектстрой РУз-
12. Ташкент:2004
13. КМК 2.01.18-00 Административные здания Госкомархитектстрой РУз- Ташкент:2000.

Additional literature:

14. КМК 2.03.10-95 Крыши и кровли. Госкомархитектстрой РУз-Ташкент: 1995. ШНК 2.08.02-09 Общественные здания и сооружения.

15. Госкомархитектстрой РУз-Ташкент:2009.
16. Здания и сооружения, приспосабливаемые под лечебные учреждения. Госкомархитектстрой РУз-Ташкент: 1997.
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27. Узгосэнергонадзор, 2005.
28. Методические указания по определению расходов топлива, электроэнергии и воды на выработку тепла отопительными котельными коммунальных теплоэнергетических предприятий. Москва, Академия коммунального хозяйства им. Памфилова, 1994 г.
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Internet sites:

1. www.gov.uz –Government portal of the Republic of Uzbekistan.
2. www.catback.ru – international scientific articles and educational materials website.
3. www.google.ru – international educational materials search website.
4. www.ziyonet.uz – national educational materials search website.
5. www.lex.uz – national database of legal documents and information.
6. www.catback.ru – scientific articles and educational materials

Name of subject	Production processes of alternative fuels (ECTS 6)
Subject/module code	MYICHJ1106
Science taught semester (s).	1st semester
Responsible teacher	Abdullaev Elnur Akhmatovich (PhD), associate professor.
Education language	English
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-180.** **Audience Training hours - 54.** Lecture training hour – 28 Practical training hour – 26 **Independent education -126 hours**
ECTS	6
The purpose and tasks of subject / learning outcomes	The purpose of teaching subject is to teach students about the processes of production of alternative fuels, the structure and principle of operation of devices used in the production, transmission and distribution of alternative energy, to process the results of experiments based on theoretical knowledge, and to verify theoretical knowledge in practice. is the formation of knowledge, skills and competences. The task of subject is to analyze the history of the development of alternative energy sources, evaluation methods, the state of the potential of alternative energy sources in the country, the typical design of alternative energy sources and their application characteristics, the use of wind and solar energy, and the analysis of the laws of obtaining alternative fuels. to have general concepts and skills in teaching methodology. **Learning outcomes:** 1. Acquaintance with the basics of production processes of alternative fuels based on modern types, methods and programs 2. Role of alternative fuel production processes in society and socio-economic importance 3. Acquaintance with production processes of alternative fuels 4. Studying the processes of production of alternative fuels using modern computer programs 5. To study technical and economic indicators of production processes of alternative fuels, their place in ecology and the principles of use 6. Increasing the efficiency of equipment for the production of alternative fuels 7. Economic assessment of the competitiveness of methods of production processes of alternative fuels 8. To know and be able to use the existing main legal and regulatory documents in the field
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** **Topic 1:** Introduction to subject. Types of alternative fuels and their preparation technologies. Main concepts and dimensions **Topic 2:** Prospects of using alternative fuels as motor fuel **Topic 3:** Use of biomass for energy purposes. Types of alternative fuel resources **Topic 4:** The future of Uzbekistan's energy industry **Topic 5:** Human internal energy and caloric content of food **Topic 6:** Problems of energy production and consumption **Topic 7:** Liquid and gas **Topic 8:** Catalysts

Topic 9: Synthesis gas. Hydrogenation of fats

Topic 10: The theory of obtaining fuel from petroleum raw materials

Topic 11: Possibilities of increasing fuel efficiency in thermal power plants

Topic 12: Combustion temperature of fuel

Topic 13: Solid fuel properly flowing burner equipment

Topic 14: To determine the difference between the lower and upper combustion heat of fuel

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. Analysis of indicators of use of alternative fuel resources in Uzbekistan
2. Environmental problems of energy in the world and in Uzbekistan
3. Problems of energy accumulation
4. Biomass is like a renewable energy source
5. Biofuels as an alternative fuel
6. Human biological power, caloric value of food
7. Problems of fuel production and consumption
8. Problems of moving energy and energy carriers
9. Obtaining energy through nuclear fission
10. Methods of obtaining energy through fusion
11. New solutions in the field of creating combined solid fuels

III. 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. Alternative energy and its development trends in the world
2. Traditional and non-traditional energy sources and types of fuel based on them
3. Dynamics of consumption of energy resources and reserves
4. The main objects of non-traditional energy of Uzbekistan
5. Types of alternative fuel resources
6. Use of biofuel for energy purposes
7. Use of biomass for energy purposes
8. Biodiesel fuels
9. Thermochemical processes
10. Alcohol and methods of obtaining it. Alcoholic fermentation
11. Use of ethanol as fuel
12. Environmental problems in the use of traditional and non-traditional energy sources
13. Compressed natural gas. Compressed petroleum gas
14. Gas condensate
15. Hydrogen fuel

	16. Metal as an alternative fuel 17. Methods of obtaining high-octane gasoline. Aromatic hydrocarbons, alkylbenzene, synthetic ethers 18. Strategy of rational use of natural gas
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. Law of the Republic of Uzbekistan "On the use of renewable energy sources" No. ORQ-539, adopted on May 21, 2019.
2. Biogas energy system for renewables: market status and technology outlook. IRENA 2015.
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3. 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”.

4. 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”.

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Internet resources:

www.lex.uz – National database of information on legal documents of the Republic of Uzbekistan.

www.ziyonet.uz – national educational materials search site.

www.google.com – international educational materials search site.

www.energystrategy.ru – “Energy Policy and Strategy” information portal

www.twirpx.com – international educational materials search site.

Name of subject	Solar heat supply systems (ECTS 6)
Subject/module code	QITT2106
Science taught semester (s).	1st semester
Responsible teacher	Abdullaev Elnur Akhmatovich, PhD., associate professor.
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-180** **Audience Training hours – 54** Lecture training hour – 28 Practical training hour – 26 **Independent education -126 hours**
ECTS	6
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** "Solar heat supply systems" – Currently, issues of widespread use of non-traditional and renewable energy sources are being widely discussed all over the world. In order to solve this problem, the task of training qualified basic personnel for bachelors and masters is set in the conditions of the Republic of Uzbekistan. In achieving this goal, such requirements are imposed as having theoretical fundamental knowledge and practical skills, knowing the history of the development of solar heat supply systems, studying the technical potential of solar gross resources, studying the basics of using thermal devices, attending round tables with scientists in the field, scientific seminars. **The objective of the course** "Solar heat supply systems" The main goal of teaching this subject is to provide students with the necessary knowledge about the use of the technical potential of solar energy in our country, the technical and economic indicators of devices, their role in ecology and the principles of use, as well as correct technical problems. To form the skills of accepting various solutions, to study the methods of converting the energy of natural energy and secondary sources into heat energy, to form the skills of drawing up the principle schemes of renewable energy source devices, to determine the power that can be received in the use of solar thermal devices with the help of calculations and formation of skills to use devices. At the same time, it is planned to learn the necessary knowledge and skills to be able to use "Solar heat supply systems" in the natural conditions of the Republic of Uzbekistan. Learning Outcomes: 1. Acquaintance with the basics of solar heat supply systems based on modern types, methods and programs; 2. Role of solar heat supply systems in society and socio-economic importance; 3. Acquaintance with solar heat supply systems; 4. Study of solar heat supply systems using modern computer programs; 5. Studying the technical and economic indicators of solar thermal devices, their place in ecology and the principles of use; 6. Increasing the efficiency of solar heat supply system equipment; 7. Economic assessment of the competitiveness of traditional and non-traditional methods of heat energy production; 8. To know and be able to use the existing main legal and regulatory documents in the field.

Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: 1. Introduction to “Solar Thermal Devices and Systems”. 2. The sun and its structure. The nature of solar radiation. Solar radiation on the Earth's surface. Straight, diffuse and global solar radiation. 3. Physical basis of converting solar energy into heat. 4. Heat exchange in the processes of condensation and boiling in heat devices. 5. Radiant heat transfer. Radiation of heat exchange between surfaces. 6. Solar thermal station (STS). Solar thermal power plant based on the Stirling engine. 7. Tower-type solar thermal station. 8. Parabolocylindrical solar thermal devices and supply systems. 9. Solar heat supply system. Flat and vacuum tube solar collectors 10. Solar collectors equipped with concentrators. 11. Basic elements of flat and vacuum solar collectors. 12. Classification of heat accumulators. 13. Use of solar energy in the heating system of rooms. 14. Solar drying devices and systems. Their working process and different constructions. **II. Instructions and recommendations for organizing laboratory exercises.** Laboratory work is not included in the curriculum **III. Practical training instructions and recommendations** The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform.Methodological guidelines serve as the primary instructional document for instructors in preparing and conducting practical sessions. The purpose of the practical session is to facilitate the comprehension of theoretical material, the acquisition of practical skills, the ability to consciously apply knowledge in academic and professional activities, and the development of critical thinking and confidence in forming personal viewpoints. *Recommended Practical Topics:* 1. Review of regulatory documents adopted in the Republic of Uzbekistan in the field of solar energy. 2. To study the methods of calculation of solar radiation flux density directly falling on an optional sloped receiver site. 3. Classification of solar energy devices and their characteristics. Study of tower solar power plants and their energy properties. 4. Study of the system of passive and active solar water heaters. Types of heat carriers and their circulation method. 5. Heliocollector heat balance. Studying the construction of the absorbing (absorbing) panel of the collector. 6. Calculation of the decrease of the mass of the Sun over time according to the results of radiation. 7. Calculation of direct, diffuse and total solar radiation falling on the horizontal surface of the Earth. 8. Calculation of heat transfer coefficients in laminar mode. Dimensionless aggregates used to summarize experimental data on convective heat transfer. 9. Performing practical calculations on determining the effective coefficients of solar radiation transmission, absorption and

	reflection for single-layer transparent coatings. 10. Calculation of flat parabolic concentrator solar power plants. Calculation of the characteristics of the solar heat supply system. 11. Calculation and design of passive solar systems. Calculation and design of active solar systems. 12. Learning the principle of operation of the concentrating solar collector. Learning the principle of operation of a flat solar collector. Calculation of the coefficient of heat loss of the solar collector. 13. Calculation of the heat balance of the flat receiver. **IIV. Independent learning and practical exercises** Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form. Recommended topics for practical exercises: 1. Single circuit solar collectors. 2. Problems of using renewable energy sources. 3. Autonomous system of providing heat to the facility. 4. Calculation of parameters of heat storage devices. 5. Planning the implementation of solar energy calculations in the modeling program. 6. Alternative and renewable energy sources. 7. Two-circuit solar collectors. 8. Solar heat supply systems for heating buildings. 9. Energy supply of autonomous solar photoelectric systems. 10. Energy distribution in a photoelectric system operating in parallel with the power grid. 11. Prospects for the use of alternative energy fuels in Uzbekistan. 12. Parabolaoid solar oven. 13. Structural systems of solar elements. 14. Thermoelectric generators. 15. Solar power plants based on thermodynamic mode. 16. Use of geothermal energy resources in the greenhouse system. 17. Application of photoelectric systems for energy supply of elevators of high-rise buildings. 18. Regulatory documents adopted in Uzbekistan in the field of solar energy.
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. Law of the Republic of Uzbekistan "On the use of renewable energy sources" No. ORQ-539, adopted on May 21, 2019. 2. Обухов С. Г Системы генерирования электрической энергии с использованием возобновляемых энергоресурсов // Учебное пособие. Издательство Томского политехнического университета. 2008. – С.140. 3. В.И. Виссирионов, Г.В. Дерюгина, В.А. Кузнецова, Н.К. Малинин Солнечная энергетика Учебное пособие для Вузов.Москва. Издательство МЭИ. 2008. С.-317. 4. Фалеев Д.С Основные характеристики солнечных модулей // Методическая указания. Хабаровск.2013. – ИздательствоДВГУПС. –С.28. 5. Gremenok V.F., Tivanov M. S., Zalesski V.B Solar cells based semiconductor materials// International Scientific Journal for Alternative Energy and Ecology – 2009 – Vol.69. №1. –P. 59-124. 6. Афанасьев В. П., Теруков Е. И., Шерченков А. А Тонкопленочные солнечные элементы на основе кремния // Санкт-Петербург. Издательство СПбГЭТУ «ЛЭТИ» 2011. 7. Андреев В.М, Грилехес В.А, Румянцев В.А. Фотоэлектрическое преобразование концентрированного солнечного излучения. Л.-Наука, 1989. 8. Ляшков В.И, Кузьмин С.Н Нетрадиционные и возобновляемые источники энергии// Учебное пособие для студентов теплоэнергетических специальностей вузов. Издательство ТГТУ –Томбов. 2003. –С.96. **Additional literature:** 9. Mirziyoyev Sh.M. Yangi O‘zbekistonda erkin va farovon yashaylik. –T.: “TASVIR nashriyot uyi”, – 2021.– 50 b. 10. Mirziyoyev Sh.M. Milliy taraqqiyot yo‘limizni qati’yat bilan davom ettirib yangi bosqichga ko‘taramiz .–T.:“O‘zbekiston”, 2017–592 b 11. 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”. 12. 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”. 13. Виссарионов В.И., Дерюгина Г.В., Кузнецова В.А., Малинин Н.К. Солнечная энергетика. Учебное пособие для вузов. – М.: Издательский дом МЭИ, 2008. 14. В.Г.Лабейш. Нетрадиционные и возобновляемые источники энергии: Учеб. пособие. - СПб.: СЗТУ, 2003. 15. Лукутин Б.В. Возобновляемые источники электроэнергии. Учебное пособие. – Томск: Изд. Томского политехнического университета, 2008. 16. Плыкин В.Д. Нетрадиционные возобновляемые источники энергии. Учеб пособие. - Ижевск: Изд. Удмуртский университет, 2013. 17. Аллаев К.Р. Энергетика мира и Узбекистана. Аналитический обзор. – Ташкент: «Молия», 2007 18. Prospects for the development of renewable energy in Uzbekistan. United Nations Development Program (Section 7). – T.: «Media Basim», 2007. 19. Trends and Prospects of Solar Energy Technologies

	Proceedings of the 6th meeting of the Asian Solar Energy Forum – Tashkent. 2013. November 20-23 – P.54. **Internet sites:** 20. www.gov.uz –Government portal of the Republic of Uzbekistan. 21. www.catback.ru – international scientific articles and educational materials website. 22. www.google.ru – international educational materials search website. 23. www.ziyonet.uz – national educational materials search website. 24. www.lex.uz – national database of legal documents and information. 25. www.catback.ru – scientific articles and educational materials.

Name of subject	Automatic systems for designing energy devices based on alternative energy sources (ECTS 6)
Subject/module code	MEMAEQLAT2106
Science taught semester (s).	1st semester
Responsible teacher	Anarboev Mukhiddin Almanovich, PhD., associate professor.
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-180** **Audience Training hours – 54** Lecture training hour – 28 Practical training hour – 26 **Independent education -126 hours**
ECTS	6
The purpose and tasks of subject / learning outcomes	**The purpose of this course** is to provide students with comprehensive theoretical and practical knowledge required for the planning, installation, and commissioning of energy systems based on alternative energy sources. The course covers a wide range of topics including the classification and reserves of renewable energy sources, principles of thermal and electrical energy generation and utilization, and the technical foundations for the deployment of alternative energy technologies. Students will study the structure and operating principles of devices powered by alternative sources, such as solar energy systems, heat pumps, low-potential energy sources, wind turbines, biogas plants, and geothermal units. The course emphasizes the practical applications of renewable energy systems, focusing on system design, energy accumulation and storage, hybrid operation of conventional and non-conventional sources, and the future prospects of the renewable energy sector. By completing this course, students will be able to develop and evaluate engineering solutions for the integration of renewable energy systems, optimize their performance, and assess their technical and economic viability for use in Uzbekistan's energy infrastructure. They will also gain awareness of ecological implications and the global shift toward sustainable energy development. **The objective of the course** *"Designing, Installation and Operational Readiness of Energy Systems Based on Alternative Energy Sources"* is to prepare future specialists in the field of renewable energy, focusing on the planning, installation, and commissioning of systems powered by alternative energy sources. Students will acquire comprehensive theoretical knowledge and practical skills related to system design, energy conversion, and integration. The course also covers the structure, operation, and technical characteristics of solar, wind, geothermal, biomass, and hydrogen-based devices. It emphasizes performance analysis, environmental and economic assessment, and system optimization. Additionally, students will participate in seminars and discussions with field experts, enabling them to make responsible, well-informed engineering decisions. **Learning Outcomes:** 1. To acquire knowledge about the planning, installation, and commissioning of energy devices based on alternative energy sources. 2. To study the structure, operating principles, and fundamental concepts of utilizing adapted energy systems. 3. To explore the global development and implementation

	processes of unconventional and renewable energy technologies (URETs). 4. To understand the methods of converting natural and secondary energy sources into thermal and electrical energy. 5. To develop skills in calculating according to assessment parameters of unconventional and renewable energy sources. 6. To build competence in drawing principle circuit diagrams of renewable energy system devices. 7. To develop the ability to determine the extractable power of devices based on renewable energy technologies through calculations and to operate such systems effectively. 8. To assess the feasibility of using renewable energy technologies in the natural conditions of the Republic of Uzbekistan.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: 1. Introduction to the course "Planning, Installation and Operational Readiness of Energy Systems Based on Alternative Energy Sources." Basic concepts, terms, and quantities 2. Power supply for decentralized consumers 3. Construction of photovoltaic batteries 4. Electrical safety requirements for photovoltaic batteries 5. Requirements for components of photovoltaic systems 6. Charge-discharge controllers and inverters in photovoltaic systems 7. Replacement, maintenance, and acceptance of devices in decentralized power supply systems 8. Designing a hot water supply system for a household providing 400–600 liters per day 9. Designing the use of combined solar heating systems and individual boilers for residential heating 10. Planning the construction of a tower-type solar power plant: site selection and analysis of solar tracking systems for heliostats 11. Manufacturing and designing a parabolic-cylindrical type solar thermal power plant 12. Designing wind energy system installations and stations 13. Designing heat pump devices 14. Designing and installing biogas energy systems 15. Developing and designing small and micro hydropower plants **II. Instructions and recommendations for organizing laboratory exercises.** Laboratory work is not included in the curriculum **III. Practical training instructions and recommendations** The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform. Recommended Practical Topics: 1. Design and technical requirements for photovoltaic batteries 2. Electrical safety standards and usage procedures for photovoltaic power stations 3. Requirements and usage procedures for photovoltaic station components 4. Charge-discharge controllers and inverters in photovoltaic systems and design-based calculation tasks 5. Inspection and technical maintenance of decentralized power supply system devices

	6. Design calculations for hot water supply systems (400–600 liters/day) for facilities 7. Design calculations for combined heliosystems and individual gas boilers in heating systems 8. Simulation of the design process of a parabolic-cylindrical type solar thermal power station 9. Design procedures for wind energy systems and stations 10. Design methods for heat pump systems 11. Design and installation of biogas systems and small/micro hydropower plants 12. Study of methods for identifying geothermal resources 13. Design of geothermal systems for heat supply **IV. Independent learning and practical exercises** Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form. Recommended topics for practical exercises: 1. Challenges in the Utilization of Renewable Energy Sources 2. Desalination of Water and Air Cooling Using Solar Energy 3. Biological, Chemical, and Mechanical Methods of Energy Storage 4. Efficiency Calculation of Hydrogen-Oxygen Fuel Cells 5. Electrical Safety Requirements and Usage Procedures of Photovoltaic Power Stationss 6. Inspection and Technical Maintenance of Decentralized Power Supply Systems 7. Methods for Processing Biomass 8. Types of Energy Obtained from Biomass Processing 9. Global Development of Biogas Technologies and Factors Influencing Biogas Production 10. Design and Installation Processes for Biogas Systems and Small/Micro Hydropower Plants 11. Study of the Electrophysical Properties of Solar Cell Batteries.
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

Main literature:

Literature	1. Qayta tiklanuvchi energiya manbalari fanidan o‘quv qo‘llanma N. T. Toshpo‘latov, D. B. Qodirov Toshkent – 2020 20-bet 2. Альтернативные источники энергии и энергосбережение : практические конструкции по использованию энергии ветра, солнца, воды, земли, биомассы / 3. В. Германович, А. Турилин. — Санкт-Петербург : Наука и Техника, 2014. — 317 с. 4. Альтернативные топливно-энергетические ресурсы: экономикоуправленческие аспекты использования в условиях инновационного развития общества / В. В. Богатырева и др. — Новополоцк : Полоцкий государственный университет, 2017. — 323 с. 5. Закон Республики Узбекистан «О рациональном использовании энергии» 1997 г. 6. Материалы широкомастабного совместного проекта ПРООН/ГЭФ и Правительства Узбекистана «Повышение эффективности зданий социального назначения в Узбекистане» 2011 г. 7. Постановление Кабинета Министров РУз №164 «Правила проведения энергетичемского аудита и энергетических экспертиз потребителей ТЭР». 07.08.2006 г. 8. Постановление Кабинета Министров Республики Узбекистан № 13 «О мерах по разработке концепции реформирования системы теплоснабжения и программы модернизации и развития системы теплоснабжения в республике на период 2009-2015 годы» 2009 г. 9. КМК 2.01.04-97 Строительная теплотехника. Госкомархитектстрой РУз- Ташкент:1997. 10. КМК 2.04.05-97 Отопление, вентиляция и кондиционирование. Госкомархитектстрой РУз-Ташкент: 1997. 11. КМК 2.08.04-04 Нормативы расхода энергии на отопление, вентиляцию и кондиционирование зданий и сооружений. Госкомархитектстрой РУз- 12. Ташкент:2004 13. КМК 2.01.18-00 Административные здания Госкомархитектстрой РУз- Ташкент:2000. **Additional literature:** 14. КМК 2.03.10-95 Крыши и кровли. Госкомархитектстрой РУз-Ташкент: 1995. ШНК 2.08.02-09 Общественные здания и сооружения. 15. Госкомархитектстрой РУз-Ташкент:2009. 16. Здания и сооружения, приспосабливаемые под лечебные учреждения. Госкомархитектстрой РУз-Ташкент: 1997. 17. Богословский В.Н., Поз М.Я.. Теплофизика аппаратов утилизации тепла систем отопления, вентиляции и кондиционирования воздуха. М., Стройиздат, 1983. 18. Энергосбережение в системах теплоснабжения, вентиляции и кондиционирования воздуха. (Справочное пособие), под ред. Богуславского Л.Д., М., Стройиздат, 1990. 19. Mirziyoev SH.M. Tankidiy taxlil, kat’iy tartib-intizom va shaxsiy javobgarlik - xar bir raxbar faoliyatining kundalik koidasi bulishi kerak. Uzbekiston Respublikasi Vazirlar Maxkamasining 2016 yil yakunlari va 2017 yil istikbollariga bagishlangan majpisidagi Uzbekiston Respublikasi Prezidentining nutqi. // “Xalq so’zi” gazetasi. 20. 2017 y.. 16 yanvar, №11. 21. O’zbekiston Respublikasi Konstitutsiyasi. - T.: Uzbekiston, 2017. - 46 b. 22. Mirziyoev SH.M. Buyuk kelajagimizni mard va olijanob

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6. www.catback.ru – scientific articles and educational materials

Name of subject	Harvesting energy from alternative energy sources (ECTS 4)
Subject/module code	MEMEY2204
Science taught semester (s).	2nd semester
Responsible teacher	Anarboev Mukhiddin Almanovich, PhD associate professor.
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-120** **Audience Training hours – 36** Lecture training hour – 18 Practical training hour – 18 **Independent education -84 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject** is to prepare students for the practical application of theoretical and practical knowledge of the process of installation, design and preparation for operation of energy devices based on alternative energy sources. It also aims to form in them knowledge, skills and qualifications appropriate to the profile of the specialist in the main types, structure, scope of use of devices based on alternative and renewable energy sources and methods of their selection in accordance with specific conditions. The task of the subject is to enable its students to; - Study devices based on alternative, QTEM; - Study the structure, principle of operation, basic principles of use of adapted energy devices; - Study the process of acquiring QTEM of unconventional energy sources on a global scale; - Study the method of converting the energy of natural energy and secondary sources into heat and electricity; - to form the ability to calculate according to unconventional and QTEM evaluation parameters; - to form the ability to draw up principle diagrams of renewable energy source devices; - to determine the power that can be received when using QTEM-based devices using calculations and to form the ability to use devices; - to study the feasibility of using QTEM in the natural conditions of the Republic of Uzbekistan. **The objective of the course** *"Harvesting Energy from Alternative Energy Sources"* is to equip students with a comprehensive understanding of the theoretical foundations and practical applications related to the design, installation, operation, and maintenance of energy systems based on alternative and renewable sources. The course aims to enable students to model and construct equivalent energy systems, analyze performance parameters, and evaluate the efficiency of various unconventional energy technologies (QTEM) under both global and region-specific conditions. Throughout the course, students will examine the structural and functional aspects of photovoltaic, wind, hydro, geothermal, hydrogen, and biogas systems. They will learn to calculate energy outputs, optimize system design for real-world applications, and evaluate sustainability metrics using modern numerical methods and simulation tools. Emphasis will be placed on the technical, environmental, and economic feasibility of integrating such technologies into the power supply infrastructure of Uzbekistan. Additionally, students will analyze the behavior of electric power systems under transient and steady-state conditions, assess the effects of

	overvoltages and discharge phenomena, and study advanced protection mechanisms. The course will prepare students to make informed decisions regarding technology selection, system scaling, and energy conversion strategies in decentralized and centralized power supply contexts. Learning Outcomes: 1. Have a clear idea and knowledge of the role of the power supply system in the energy system, saving electricity, and its proper distribution to consumers; 2. Know the basic concepts of the field and their essence, initial information on the design of consumer power supply systems, as well as the specific features of the use of traditional and non-traditional energy sources and have the skills to use them; 3. Must be able to study and analyze existing problems in the field of uninterrupted and high-quality heat and energy supply to consumers and adopt initial solutions to these problems.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: 1. Introduction to the science of designing and preparing for operation the installation of energy devices based on alternative energy sources. Basic concepts, terms and quantities. 2. Power supply of decentralized consumers. 3. Constructions of photovoltaic cells. 4. Electrical safety requirements for photovoltaic batteries. 5. Requirements for photovoltaic battery components. 6. Charge-discharge controllers and inverters in photovoltaic systems 7. Replacement, maintenance and acceptance of devices in decentralized power supply systems. 8. Design of hot water supply for a house with a capacity of 400-600 l / day. 9. Design of a combined solar system and individual boilers for a house heating system. 10.Design of tower-type solar power plant construction, site selection, consideration of solar tracking systems for heliostats. 11.Production and design of a parabolic-cylindrical solar thermal power station. 12.Design of wind energy plants. 13.Design of heat pump devices. 14.Design and installation of biogas devices. 15.Development and design of small and micro hydroelectric power plants. **II. Instructions and recommendations for organizing laboratory exercises.** Laboratory work is not included in the curriculum **III. Practical training instructions and recommendations** The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform.Methodological guidelines serve as the primary instructional document for instructors in preparing and conducting practical sessions. The purpose of the practical session is to facilitate the comprehension of theoretical material, the acquisition of practical skills, the ability to consciously apply knowledge in academic and professional activities, and the development of critical thinking and confidence in forming personal viewpoints.

Recommended Practical Topics:

1. Determining parameters of elements and developing equivalent circuits for short-circuit calculations
2. Calculating symmetrical and asymmetrical short-circuit conditions using various methods
3. Calculating and analyzing the static stability of an electric power system
4. Analyzing the dynamic stability of an electric power system
5. Characteristics of the electric field
6. Electrical insulation materials
7. Power supply and distribution equipment
8. Solving problems related to breakdown, flashover, and discharge voltages in dielectrics
9. Protection of system elements against direct lightning strikes
10. Solving problems related to the selection of lightning arresters and grounding resistance
11. Selection of surge arresters
12. Solving problems related to atmospheric and internal overvoltages and the use of surge arresters for protection
13. Solving problems related to the lightning resistance of overhead transmission lines
14. Examination of visible corona discharge on conductors of overhead transmission lines
15. Study of voltage distribution along suspension insulator strings

IIV. Independent learning and practical exercises

Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form.

Recommended topics for practical exercises:

1. Analysis of parameters, characteristics and energy indicators of energy devices based on alternative and renewable energy sources and other data.
2. Study and analysis of issues of power supply of unmarked consumers.
3. Constructions of photovoltaic batteries and requirements for them.
4. Requirements for electrical safety of photovoltaic stations and procedures for their use.
5. Requirements for components of photovoltaic stations and procedures for their use.
6. Charge-discharge controllers and inventories in photovoltaic systems and calculations for their design.
7. Inspection and maintenance of devices of decentralized power supply systems.
8. Calculations for the design of hot water supply of 400-600 l / day for hot water supply of facilities.
9. Design calculations for the use of combined solar systems and individual gas boilers for heating systems.
10. Design calculations for the construction of tower-type solar thermal power plants.
11. Modeling the design processes of a parabolic trough solar thermal power plant.
12. Design procedures for wind energy installations and stations.
13. Design methods for heat pump installations.
14. Design and installation of biogas installations.
15. Design processes for small and micro hydroelectric power

	plants. 16. Study of the methodology for determining geothermal resources 17. Study of the design of a geothermal system providing heat 18. Calculation of two-circuit geothermal power plants 19. Calculation of one-circuit geothermal power plants 20. Calculation of the FIC of a hydrogen-oxygen fuel cell 21. Study of the electrophysical properties of a solar cell battery 22. Calculation of solar power plants with a flat parabolic concentrator Practical classes are conducted by one professor per academic group in an auditorium equipped with multimedia devices. Classes are conducted using active and interactive methods, and it is desirable to arouse interest in the requirements for the possibilities of deepening knowledge through the use of appropriate pedagogical and information technologies, to provide the opportunity to independently achieve the result, and to prepare theoretically and methodologically.
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. Twidell J.W., Wier A.D. Renewable Energy Resources. London, 2015.
2. Gemma Herranz, Gloria P.Rodrnguez. Uses of Concentrated Solar Energy in Materials Science.-Spain; INTECH, 2010. ISBN 978-953-307-052-0
3. S.A.Nikonov, A.A Goryayev, S.V Petuxov, N.B. Balanseva, S.V Butakuv. Netraditsionnie istochniki energii v agropromishlennom komplekse. Metodicheskiye ukazaniya dlya provedenya prakticheskix zanyatiy. Novosibrsk-2018.
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Additional literature:

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12.Volker Quaschning. Understanding Renewable Energy System. Warthscan, London, 2016. ISBN 978-113878-196-2.

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14.Word Energy Council. For sustainable energy. Copyright 2013 World Energy Council, London, www.worldenergy.org. ISBN; 978-0-946121-29-8.Vissarionov V.I., Deryugina G.V., Kuznetsova V.A., Malinin N.K., Solnechnaya energetika. Uchebnoye posobiye dlya vuzov.-M; Izdatelskiy dom MEI, 2008.

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16.Muxammadiev M.M., Urishev B.U., Djuraev K.S., Gidroenergetik qurilmalar. Darslik.- Toshkent; Fan va texnologiya-2015.

Internet sites:

17. www.gov.uz –Government portal of the Republic of Uzbekistan.

18. www.catback.ru – international scientific articles and educational materials website.

19. www.google.ru – international educational materials search website.

20. www.ziyonet.uz – national educational materials search website.

21. www.lex.uz – national database of legal documents and information.

22. www.catback.ru – scientific articles and educational materials.

Name of subject	Physics and technology of modern solar cells (ECTS 4)
Subject/module code	ZQEFT2204
Science taught semester (s).	1st and 2nd semesters
Responsible teacher	Yuldashev Urishbay, professor.
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-120** **Audience Training hours – 36** Lecture training hour – 18 Practical training hour – 18 **Independent education -84 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** The course aims to provide students with in-depth theoretical knowledge and practical skills in the physical foundations of photovoltaic conversion processes, the structure, operating principles, materials, technological production stages and their practical applications of solar cells. Through this subject, students will learn modern methods of converting solar energy into electricity, various photovoltaic technologies, ways to increase their efficiency, and the use of PV systems in real projects. Students will also learn about innovations and promising trends in the global solar energy market. **The objective of the course** "Physics and technology of modern solar cells" is to familiarize students with the physical foundations of solar energy, the photoelectric conversion process, the structure of solar cells, the principle of operation, the selection of materials and the technologies for their preparation. The course allows students to analyze the physical factors affecting the efficiency of solar cells, calculate them, compare modern PV (photovoltaic) technologies and form the necessary theoretical knowledge and practical skills in applying them in real energy projects. Learning Outcomes: 1. Knows the physics of the process of converting solar energy into electricity; 2. Has a complete understanding of the structure, operating principle and types of PV elements; 3. Understands the differences between solar elements based on different materials (silicon, perovskite, organic, GaAs); 4. Knows how to measure and analyze the I–V characteristics of solar cells; 5. Master practical calculations of PV system efficiency; 6. Perform simple experiments related to solar panels in the laboratory; 7. Use software tools for designing solar systems (e.g. PV*Sol, HelioScope); 8. Can think freely in the field of energy sources, energy conservation and "green technologies".
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: 1. Introduction to solar energy. Theory of the photoelectric effect. 2. Physical foundations of semiconductors: PN junction, energy bands. 3. Electrical properties and operating modes of a solar cell. 4. Silicon-based PV: monocrystalline, polycrystalline.

	5. Unconventional PV: perovskite, organic and quantum-dot elements. 6. Photocurrent generation and losses: types of recombination. 7. Efficiency: Shockley–Queisser limit and practical evaluation. 8. Production stages of PV technologies. 9. Solar cells and energy storage systems. **II. Instructions and recommendations for organizing laboratory exercises.** Laboratory work is not included in the curriculum **III. Practical training instructions and recommendations** The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform.Methodological guidelines serve as the primary instructional document for instructors in preparing and conducting practical sessions. The purpose of the practical session is to facilitate the comprehension of theoretical material, the acquisition of practical skills, the ability to consciously apply knowledge in academic and professional activities, and the development of critical thinking and confidence in forming personal viewpoints. *Recommended Practical Topics:* 1. Measuring the I-V characteristic of a solar cell. 2. Photon flux measurement and efficiency determination. 3. Analyzing the effect of anti-reflective coating. 4. Assembling and testing a small solar system. 5. Photovoltaic system design through simulation (PV*Sol, HelioScope). 6. Determining the operating point of a solar cell under load. 7. Determining efficiency in natural light conditions. 8. Study of the optical efficiency of anti-reflective coating. 9. Studying parallel and series connection modes of PV modules **IIV. Independent learning and practical exercises** Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form. Recommended topics for practical exercises: 1. Historical Development of Solar Cells. 2. Perovskites: Opportunities and Sustainability Challenges 3. Off-grid PV System Design 4. Analysis of Smart Solar Devices 5. Economic Analysis of Solar Power Plants (LCOE, CAPEX)
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. Gulyamov M.M., Rashidov A.A.Quyosh fotoelektr konvertorlari – TATU nashriyoti, Toshkent, 2020.
2. Gulyamov M.M., Abdurahmanov N.Yarimo‘tkazgichlar fizikasi – Toshkent, 2018.
3. Baxodirov Sh.B., Karimov K.K.Quyosh energiyasi va fotovoltaik tizimlar – Samarqand davlat universiteti, 2021.
4. Peter Würfel Physics of Solar Cells: From Basic Principles to Advanced Concepts – Wiley-VCH, 2016 (3rd ed.)
5. Stephen J. Fonash Solar Cell Device Physics – Academic Press, 2010 (2nd ed.)
6. Antonio Luque, Steven Hegedus (eds.) Handbook of Photovoltaic Science and Engineering – Wiley, 2011 (2nd ed.)
7. Jenny Nelson The Physics of Solar Cells – Imperial College Press, 2003.
8. Martin Green Third Generation Photovoltaics: Advanced Solar Energy Conversion – Springer, 2006.

Additional literature:

9. Mirziyov 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 yil 16 yanvar, №11.
10. Mirziyoyev Sh.M. Erkin va farovon, demokratik O‘zbekiston davlatini birgalikda barpo etamiz. O‘zbekiston Respublikasi Prezidentining lavozimiga kirishish tantanali marosimiga bag‘ishlangan Oliy Majlis palatalarining qo‘shma majlisidagi nutqi. –T.: “O‘zbekiston” NMIU, 2016. – 56 b.
11. Mirziyoyev Sh.M. Buyuk kelajagimizni mard va olijanob xalqimiz bilan birga quramiz. - T.: “O‘zbekiston” NMIU, 2017. – 488 b.
12. The Electric Power Engineering Handbook, Third Edition - Five Volume Set (Electrical Engineering Handbook), 2012 by Leonard L. Grigsby.

Internet sites:

13. www.gov.uz –Government portal of the Republic of Uzbekistan.
14. www.catback.ru – international scientific articles and educational materials website.
15. www.google.ru – international educational materials search website.
16. www.ziyonet.uz – national educational materials search website.
17. www.lex.uz – national database of legal documents and information.
18. www.catback.ru – scientific articles and educational materials
19. https://www.nrel.gov– National Renewable Energy Laboratory
20. https://www.ise.fraunhofer.de- Fraunhofer Institute for Solar Energy Systems.

Name of subject	Hydrogen technologies (ECTS 4)
Subject/module code	VT2204
Science taught semester (s).	2nd semester
Responsible teacher	Nazarov Furkat, PhD., senior teacher.
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-120** **Audience Training hours – 36** Lecture training hour – 18 Practical training hour – 18 **Independent education -84 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** To provide students with modern theoretical knowledge and practical skills in hydrogen energy technologies, to introduce them to methods of hydrogen production, storage, transportation and use, and to prepare them to design environmentally safe and sustainable energy systems. The subject also aims to prepare students to conduct independent analysis and research within the framework of hydrogen economy, energy policy, safety standards and technological innovations. **The objective of the course** "Hydrogen technologies" to provide students with in-depth theoretical knowledge and solid practical skills in advanced areas of hydrogen energy and technologies; to analyze technologies for the production, storage, transportation and use of hydrogen in accordance with modern environmental and economic requirements, as well as to prepare them to conduct independent research and innovative design activities. Learning Outcomes: 1. Understands the scientific basis of hydrogen technologies; 2. Demonstrates practical hydrogen production, storage, and use; 3. Knows the basics of design, modeling, and security; 4. Can make a scientific or practical contribution to the development of green energy;
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: 1. Hydrogen Energy: Introduction and Basic Concepts. 2. Physicochemical properties of hydrogen. 3. Hydrogen production methods (steam reforming, pyrolysis, electrolysis). 4. Electrolysis Technologies: Green Hydrogen Production. 5. Thermochemical and biological production methods. 6. Hydrogen storage technologies: gaseous, liquid and metal hydrides. 7. Fuel Cells: Types, Operating Principle. 8. Hydrogen applications in automotive, aviation, and industry. 9. Hydrogen strategies in developing countries. **II. Instructions and recommendations for organizing laboratory exercises.** Laboratory work is not included in the curriculum **III. Practical training instructions and recommendations** The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of

	the practical session, as well as the amount of work each student is expected to perform.Methodological guidelines serve as the primary instructional document for instructors in preparing and conducting practical sessions. The purpose of the practical session is to facilitate the comprehension of theoretical material, the acquisition of practical skills, the ability to consciously apply knowledge in academic and professional activities, and the development of critical thinking and confidence in forming personal viewpoints. *Recommended Practical Topics:* 1. Experiment on obtaining hydrogen by electrolysis. 2. Assembling and running a fuel cell model. 3. Hydrogen storage and measurement methods. 4. Working with a gas analyzer in safety conditions. 5. Study of the physicochemical properties of hydrogen. 6. Analysis of hydrogen production methods. 7. Fuel cells and their operating principles. 8. Integration of hydrogen and renewable energy sources. **IIV. Independent learning and practical exercises** Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form. Recommended topics for practical exercises: 1. Hydrogen is the clean fuel of the future. 2. Advantages and disadvantages of hydrogen as an energy source. 3. Hydrogen production through electrolysis technology. 4. Hydrogen fuel cells and their operating principle. 5. Hydrogen storage and transportation technologies. 6. Integrating hydrogen into energy systems. 7. Environmental advantages of hydrogen energy. 8. Towards a carbon-neutral economy: the role of hydrogen. 9. Hydrogen and the Sustainable Development Goals. 10. Hydrogen economy: development prospects and global competition. 11. Hydrogen policy in countries around the world (Germany, Japan, Saudi Arabia, South Korea). 12. Prospects for the development of hydrogen energy in Uzbekistan. 13. Hydrogen in industry: iron production, chemical industry, etc.. 14. Integration of hydrogen and renewable energy sources.
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. Gupta, R. B. Hydrogen Fuel: Production, Transport, and Storage. CRC Press. 2008 2. Turner, J. A. A Realizable Renewable Energy Future. Science, 305(5686), 972–974.2004 3. Sorensen, B. Hydrogen and Fuel Cells: Emerging Technologies and Applications. Elsevier Academic Press. 2005 4. Larminie, J., & Dicks, A. Fuel Cell Systems Explained. 2nd Ed. John Wiley & Sons. 2003 5. Ramazonov, M., & G‘aybullayev, A. Vodorod olish usullari va uning tasnifi. O‘zbek ilmiy jurnali, openscience.uz.2024 6. Yartys, V. A., Materials for hydrogen-based energy storage – past, recent progress and future outlook. Journal of Alloys and Compounds, 817, 153261.2020 7. International Energy Agency (IEA).The Future of Hydrogen: Seizing today’s opportunities. Paris: IEA.2021 8. Techtitute Professional Master’s Degree in Hydrogen Technology.2024 www.techtitute.com **Additional literature:** 9. Mirziyoyev Sh.M. Yangi O‘zbekistonda erkin va farovon yashaylik. –T.: “TASVIR nashriyot uyi”, – 2021.– 50 b. 10. Mirziyoyev Sh.M. Milliy taraqqiyot yo‘limizni qati’yat bilan davom ettirib yangi bosqichga ko‘taramiz .–T.:“O‘zbekiston”, 2017–592 b 11. 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”. 12. Aalto University Master's Programme in Hydrogen and Electric Systems – Curriculum 2024–2026. 2024 www.aalto.fi 13.Birmingham University. Hydrogen, Fuel Cells and Their Applications MSc. www.birmingham.ac.uk 2024 14.TH Rosenheim University Master of Hydrogen Technology. www.th-rosenheim.de 2024 15.Cyber Leninka. Vodorod ishlab chiqarish usullarining tahlili. cyberleninka.ru 2023 16.Slibrary. Piroliz usulida chiqindilardan vodorod olish texnologiyasi. 2023 www.slibrary.uz 17.Bard, A. J., & Faulkner, L. R. Electrochemical Methods: Fundamentals and Applications. Wiley 2001. **Internet sites:** 18. www.gov.uz –Government portal of the Republic of Uzbekistan. 19. www.catback.ru – international scientific articles and educational materials website. 20. www.google.ru – international educational materials search website. 21. www.ziyonet.uz – national educational materials search website. 22. www.lex.uz – national database of legal documents and information. 23. www.catback.ru – scientific articles and educational materials.

Name of subject	Modern wind energy devices and systems (ECTS 4)
Subject/module code	ZSHEQT2204
Science taught semester (s).	1st and 2nd semesters
Responsible teacher	Abdullaev Elnur Akhmatovich, PhD., associate professor
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-120** **Audience Training hours – 36** Lecture training hour – 18 Practical training hour – 18 **Independent education -84 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject is** The purpose of teaching science is to prepare the ground for students to be able to apply theoretical and practical knowledge of the process of installation, design and preparation for operation of energy devices based on modern wind energy sources. They also include the formation of knowledge, skills and qualifications in accordance with the professional profile on the main types, structure, scope of use of devices based on alternative and renewable energy sources and methods of selecting them in accordance with specific conditions. **The objective of the course** "Modern wind energy devices and systems" The task of science is to know the history of the development of wind energy, to understand the law of nature of wind and the specific characteristics of using wind as a resource, to know the wind atlas, to assess the wind potential of regions and buildings, to know the methods, the classification and typical design of wind devices of different capacities, including the elements of structures and to know the characteristics of their application, to understand the methods of analyzing the aerodynamics of wind turbines, to know their operation and maintenance, to know their characteristics, to understand the methods of analyzing the economic efficiency of wind energy, the world and to have an understanding of the prospects of further development of wind energy in our country. Learning Outcomes: 1. Familiarity with modern wind energy devices and systems; 2. The role and socio-economic importance of modern wind energy devices and systems in society; 3. To know the classification and typical design of wind turbines of different capacities, including the elements of structures and their application features; 4. Study of modern wind energy devices and systems with the help of computer programs; 5. To study the technical and economic indicators of modern wind energy devices and systems, their place in ecology and the principles of use; 6. Improving the performance of modern wind energy devices and systems; 7. Economic evaluation of the competitiveness of traditional and non-traditional methods of electricity production; 8. To know and be able to use the existing main legal and regulatory documents in the field.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics:

1. History of wind energy development.
2. Wind energy assessment methods.
3. The state of wind potential of our country.
4. Features of the design and application of modern wind energy.
5. Information about modern anemometers.
6. Parts of modern wind power plants.
7. Learning the drawing of the tower. Determining the location of the foundation and section parts.
8. Installation of trench pits and cable channels for the foundation.
9. Placement of soil layers for lining.

II. Instructions and recommendations for organizing laboratory exercises.

Laboratory work is not included in the curriculum

III. Practical training instructions and recommendations

The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform.Methodological guidelines serve as the primary instructional document for instructors in preparing and conducting practical sessions. The purpose of the practical session is to facilitate the comprehension of theoretical material, the acquisition of practical skills, the ability to consciously apply knowledge in academic and professional activities, and the development of critical thinking and confidence in forming personal viewpoints.

Recommended Practical Topics:

1. Analysis of characteristics of anemometers and roto anemometers.
2. Analysis of wind energy reserves.
3. Calculation of ideal and real efficiency coefficients of wind generators.
4. Analysis of wind speed characteristics.
5. Determining the parameters of wind energy devices.
6. Calculation of comparative norms.
7. Determination of technical and economic indicators of wind energy devices.
8. Calculation of the process of converting wind energy into electricity.

IIV. Independent learning and practical exercises

Independent learning competency helps students to develop self-improvement skills and increase the efficiency of their professional activities. Students perform independent tasks on their mobile devices under the guidance of a teacher, either in traditional or electronic form.

Recommended topics for practical exercises:

1. Features of the design and application of modern wind energy.
2. Information about modern anemometers.
3. Parts of modern wind power plants.
4. Study the drawing of the tower. Determining the location of the foundation and section parts.
5. Installation of trench pits and cable channels for the foundation.
6. Placing soil layers for priming.
7. Analysis of characteristics of wind gauges and roto anemometers.
8. Analysis of wind energy reserves.
9. Calculation of ideal and real efficiency coefficients of wind generators.
10. Analysis of wind speed characteristics.
11. Determining the parameters of wind energy devices.

	12. Calculation of comparative norms. 13. Determination of technical and economic indicators of wind energy devices. 14. Calculation of the process of converting wind energy into electricity.
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. Law of the Republic of Uzbekistan "On the use of renewable energy sources" No. ORQ-539, adopted on May 21, 2019.
2. Обухов С. Г Системы генерирования электрической энергии с использованием возобновляемых энергоресурсов // Учебное пособие. Издательство Томского политехнического университета. 2008. – С.140.
3. Majidov T. Noana’naviy va qayta tiklanuvchan energiya manbalari. Darslik – T: “Voris nashriyoti”, 2014.
4. Muxammadiyev M.M, Tashmatov X.K. Energiya yig‘uvchi qurilmalar. Darslik – T: “Yangi nashr”, 2010.
5. Лукутин Б.В. Возобновляемые источники электроэнергии. Учебное пособие. – Томск: Изд. Томского политехнического университета, 2008.
6. Плыкин В.Д. Нетрадиционные возобновляемые источники энергии. Учеб пособие. - Ижевск: Изд. Удмуртский университет, 2013.
7. Tony Burton., David Sharpe., Nick Jenkins., Ervin Bossanyi. Wind Energy. Handbook. 2001 by John Wiley & Sons, Ltd Baffins Lane, Chichester West Sussex, PO19 1UD, England.
8. Pramod Jain. Wind Energy Engineering. 2011 by The McGraw-Hill Companies, Inc.

Additional literature:

9. Mirziyoyev Sh.M. Yangi O‘zbekistonda erkin va farovon yashaylik. –T.: “TASVIR nashriyot uyi”, – 2021.– 50 b.
10. Mirziyoyev Sh.M. Milliy taraqqiyot yo‘limizni qati’yat bilan davom ettirib yangi bosqichga ko‘taramiz .–T.:“O‘zbekiston”, 2017–592 b
11. 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”.
12. 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”.
13. В.Г.Лабейш. Нетрадиционные и возобновляемые источники энергии: Учеб. пособие. - СПб.: СЗТУ, 2003.
14. Лукутин Б.В. Возобновляемые источники электроэнергии. Учебное пособие. – Томск: Изд. Томского политехнического университета, 2008.
15. Плыкин В.Д. Нетрадиционные возобновляемые источники энергии. Учеб пособие. - Ижевск: Изд. Удмуртский университет, 2013.
16. Аллаев К.Р. Энергетика мира и Узбекистана. Аналитический обзор. – Ташкент: «Молия», 2007
17. Prospects for the development of renewable energy in Uzbekistan. United Nations Development Program (Section 7). – T.: «Media Basim», 2007.
18. Trends and Prospects of Solar Energy Technologies Proceedings of the 6th meeting of the Asian Solar Energy Forum – Tashkent. 2013. November 20-23 – P.54.
Internet sites:
19. www.gov.uz –Government portal of the Republic of Uzbekistan.
20. www.catback.ru – international scientific articles and educational materials website.
21. www.google.ru – international educational materials search website.
22. www.ziyonet.uz – national educational materials search website.
23. www.lex.uz – national database of legal documents and information.
24. www.catback.ru – scientific articles and educational materials.

<table>
<tr><td>Name of subject</td><td>Scientific research and academic-pedagogical work, preparation of a master's dissertation (ECTS 38)</td></tr>
<tr><td>Subject/module code</td><td>ITIMDT3123438</td></tr>
<tr><td>Science taught semester (s).</td><td>1st / 2nd / 3rd / 4th semesters</td></tr>
<tr><td>Responsible teachers</td><td>Abdullaev Elnur Akhmatovich, Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor
Anarboev Mukhiddin Almanovich, Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor
Nazarov Furkat Daminovich, Doctor of Philosophy (PhD) in Technical Sciences, senior teacher.
Yuldashe Urishbay, Doctor of Physics and Mathematics, professor
Parsoxonov Abdulkobi Gafurovich, Candidate of Physical and Mathematical Sciences, Associate Professor.</td></tr>
<tr><td>Education language</td><td>Uzbek</td></tr>
<tr><td>Connection to the curriculum</td><td>Compulsory</td></tr>
<tr><td>Training hours (this including independent education)</td><td>Total hours-180
<table><tr><td>Semester</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Total workload</td><td>150</td><td>90</td><td>300</td><td>600</td></tr></table></td></tr>
<tr><td>ECTS</td><td>38</td></tr>
<tr><td>The purpose and tasks of discipline / learning outcomes</td><td>The purpose of the discipline is to prepare the master's student for independent research and pedagogical work, the main result of which is writing a master's thesis, conducting experiments, organizing pedagogical practice, and successfully defending the dissertation.
Learning outcomes
- the ability to apply methods of scientific knowledge in independent research activities, generate and implement innovative ideas;
- own the methodology of scientific knowledge, be able to analyze and evaluate the content and level of philosophical and methodological problems when solving problems of research and innovation activities;
- designing and conducting comprehensive, systematic scientific research based on knowledge and skills in the field of energy, including innovative studies;
- have the skills to use modern information technologies to solve research and innovation problems;
- conducting scientific research activities in the field of energy using modern research methods and information and communication technologies;
- adapt the results of modern energy and technical research to solve problems in the electric power system.</td></tr>
<tr><td>Course content (topics)</td><td>1. The relevance and necessity of the scientific research topic.
2. Selecting and Approving a Master's Thesis Topic.
3. The purpose and objectives of the master's dissertation.
4. The procedure and rules for structuring the dissertation contents.
5. The procedure and methods for conducting a literature review within the scope of the dissertation topic.
6. Conducting experiments within the scope of the dissertation work.
7. Conducting Experimental Research on the Scientific Topic, Summarizing and Analyzing the Results.
8. Preparing and Publishing Scientific Theses and Articles Based on the Research Conducted and the Results Obtained for the Master's Dissertation.</td></tr>
</table>

	9. Applying the Research Conducted and Its Results from the Master's Dissertation to Practical Use. 10. Studying Existing Problems in Practice within the Framework of the Master's Dissertation and Developing Recommendations for Their Scientific Solutions. 11. Participating in Various Conferences and Scientific Seminars and Delivering Presentations Based on the Conducted Research Work.
Exam form	The report will be submitted in the form of a presentation
Teaching/learning and examination requirements	No more than 3 days are allotted for drawing up the final report, during which masters put their individual plan in order, prepare written reports, and prepare presentations. Each masters submits the following materials: - Report text; - Individual plan and characteristics from the supervisor; - Presentations of master's students-interns in electronic form. The credit for research activities (practice) is accepted by the commission in accordance with the approved order, in the presence of all masters and their supervisors. During the certification, the competencies of master's students-interns, which they mastered in the process of carrying out research activities (practice), are assessed.
Criteria for assessing student knowledge	
Criteria for evaluating students' scientific research, pedagogical work, and the tasks completed during the preparation of their master's thesis	

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.

S/n	Name of events and tasks	Allocated points	Report form
1	The relevance and necessity of the scientific research topic.	0-5	A report in the form of a presentation will be prepared on the relevance and necessity of the research topic.
2	Selecting and Approving a Master's Thesis Topic.	0-5	A report in the form of a presentation will be prepared on the selection and approval of the

				master’s thesis topic
		3	The purpose and objectives of the master's dissertation.	0-5	A report in the form of a presentation will be prepared on the objectives and tasks of the master’s thesis
		4	The procedure and rules for structuring the dissertation contents.	0-5	A report in the form of a presentation will be prepared on the structure and formatting rules of the thesis content
		5	The procedure and methods for conducting a literature review within the scope of the dissertation topic	0-10	A report in the form of a presentation will be prepared on the procedure and methods of analyzing literature related to the thesis topic
		6	Conducting experiments within the scope of the dissertation work.	0-15	A report in the form of a presentation will be prepared on conducting experiments within the framework of the thesis wor
		7	Conducting Experimental Research on the Scientific Topic, Summarizing and Analyzing the Results.	0-15	A report in the form of a presentation will be prepared on conducting experimental research on the scientific topic, summarizing and analyzing the results
		8	Preparing and Publishing Scientific Theses and Articles Based on the Research Conducted and the Results Obtained for the Master's Dissertation.	0-10	A report in the form of a presentation will be prepared on preparing and publishing scientific theses and articles based on the conducted research for the master’s thesis.
		9	Applying the Research Conducted and Its Results from the Master's Dissertation to Practical Use.	0-10	A report in the form of a presentation will be prepared on the practical application of the research and its results conducted within the framework of the master’s thesis
		10	Studying Existing Problems in Practice within the Framework of the Master's Dissertation and Developing Recommendations for Their Scientific	0-10	A report in the form of a presentation will be prepared on studying existing practical problems within the thesis framework and developing scientific recommendations for their solution

	Solutions.		
11	Participating in Various Conferences and Scientific Seminars and Delivering Presentations Based on the Conducted Research Work.	0-10	A report in the form of a presentation will be prepared on participating in various conferences and scientific seminars and delivering presentations based on the conducted research

* 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. Law of the Republic of Uzbekistan “On electric energy”. Received June 24, 2009.
2. “On introducing amendments and additions to the Resolution 'On the approval of the rules for the preparation of doctoral dissertations and dissertation abstracts” Decision of the Presidium of the Higher Attestation Commission under the Cabinet of Ministers of the Republic of Uzbekistan, registered on June 23, 2017, registration number 2665-1.
3. State standard ISO 50001-2012. Energy management systems. National norm. Requirements and ISO 50001: 2011. Guidance on the application of energy management systems - Requirements with an Operation Guide (IDT).
4. O.O. Hoshimov. A.T. Imomnazarov. Elektr mexanik tizimlarda energiya tejamkorligi. Toshkent-2015. “Fan va texnologiya” nashriyoti.
5. Xoshimov O. Sanoat korxonalarining elektr jihozlari montaji, Toshkent,-2007.
6. Majidov. Noana’naviy va qayta tiklanuvchi energiya manbalari. Toshkent-2014.
7. M.A. Graña-López, A. García-Diez, A. Filgueira-Vizoso, J. Chouza-Gestoso and A. Masdías-Bonome. Study of the Sustainability of Electrical Power Systems: Analysis of the Causes that Generate Reactive Power. Sustainability 2019, 11, 7202; doi:10.3390/su11247202.
8. Raxmonov I.U. “Elektr ta’minoti asoslari”. Darslik. Toshkent: 2019, 226 b.

Additional literature:

1. Mirziyoyev Sh.M. Yangi O‘zbekistonda erkin va farovon yashaylik. –T.: “TASVIR nashriyot uyi”, – 2021.– 50 b.
2. Mirziyoyev Sh.M. Milliy taraqqiyot yo‘limizni qati’yat bilan davom ettirib yangi bosqichga ko‘taramiz .–T.:“O‘zbekiston”, 2017–592 b.
3. 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”.
4. 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”.
5. General Aspects of Energy Management And Energy Audit. Guide Book For National Certification Examination For Energy Auditors and Managers.
6. Xoshimov F.A., Taslimov A.D. Energiya tejamkorligi asoslari. O‘quv qo‘llanma. – T.: “Voris”, 2014 – 192 bet.
7. Аллаев К.Р., Хошимов Ф.А. Энергосбережение в

	промышленных предприятиях, Монография. – Т.:Fan. 2012. 8. Aripov N. M. Elektr stansiyalarning elektr jihozlari, Toshkent,-2005 **Internet resources:** www.lex.uz – National database of information on legal documents of the Republic of Uzbekistan. www.ziyonet.uz – national educational materials search site. www.gov.uz – Government portal of the Republic of Uzbekistan. www.google.com – international educational materials search site. www.energystrategy.ru – “Energy Policy and Strategy” information portal www.twirpx.com – international educational materials search site.

<table>
<tr><th>Name of subject</th><th>Scientific and pedagogical work (ECTS 12)</th></tr>
<tr><td>Semester(s) in which the discipline is taught</td><td>1st / 2nd / 3rd semesters</td></tr>
<tr><td>Responsible teacher</td><td>Abdullaev Elnur Akhmatovich, Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor
Anarboev Mukhiddin Almanovich, Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor
Nazarov Furkat Daminovich, Doctor of Philosophy (PhD) in Technical Sciences, senior teacher.
Yuldashe Urishbay, Doctor of Physics and Mathematics, professor
Parsoxonov Abdulkobi Gafurovich, Candidate of Physical and Mathematical Sciences, Associate Professor.</td></tr>
<tr><td>Education language</td><td>Uzbek</td></tr>
<tr><td>Connection to the curriculum</td><td>Compulsory</td></tr>
<tr><td>Training hours</td><td>Total hours-360
<table><tr><td>Semester</td><td>1</td><td>2</td><td>3</td></tr><tr><td>Total workload</td><td>120</td><td>90</td><td>150</td></tr></table></td></tr>
<tr><td>ECTS</td><td>12</td></tr>
<tr><td>Discipline objectives / Learning Outcomes</td><td>The purpose of the discipline is to acquire practical skills in teaching; the formation of professional competence, manifested in the readiness to develop models of Electric power industry classes, analyze them taking into account psychological, pedagogical and scientific-methodological requirements.
Learning outcomes
- the ability to apply methods of scientific knowledge in independent research activities, generate and implement innovative ideas;
- own the methodology of scientific knowledge, be able to analyze and evaluate the content and level of philosophical and methodological problems when solving problems of research and innovation activities;
- have the skills to use modern information technologies to solve research and innovation problems;
- the ability to carry out pedagogical activities in educational institutions, to master and implement effective educational and information and communication technologies, pedagogical innovations;
- master the techniques and methods of personal and professional development of a teacher-researcher, building a professional career and pedagogical ideals, norms and principles of pedagogical and scientific ethics, individual abilities and inclinations, etc.</td></tr>
<tr><td>Lessons’ contents</td><td>Content
1. Current problems of Higher education, innovative and scientific-pedagogical activities
2.Methodology of scientific and pedagogical research
3.Information and communication technologies in scientific, pedagogical and innovative activities</td></tr>
</table>

<table>
<tr><td></td><td>4.Innovations in the History of Education as a Driving Factor of Development
5.Pedagogy and psychology of higher education
6.Management in Education
7.Teacher's personal effectiveness
8.Innovative approaches and technologies in education
9.Socialization and education in the context of global challenges and risks
10. Pedagogical skills and their formation</td></tr>
<tr><td>The exam format</td><td>Preparation of the report and its protection</td></tr>
<tr><td>Teaching/learning and examination requirements</td><td>No more than 3 days are allotted for drawing up the final report, during which masters put their individual plan in order, prepare written reports, and prepare presentations. Each masters submits the following materials:
- Report text;
- Individual plan and characteristics from the supervisor;
- Presentations of master's students-interns in electronic form.
The credit for research activities (practice) is accepted by the commission in accordance with the approved order, in the presence of all masters and their supervisors.
During the certification, the competencies of master's students-interns, which they mastered in the process of carrying out research activities (practice), are assessed.</td></tr>
<tr><td>CRITERIA for evaluating the tasks performed by students during their Master's degree scientific practice and research work and master's thesis preparation practice</td><td>
<table>
<tr><th>T/r</th><th>Name of events and tasks</th><th>Allocated points</th><th>Report form</th></tr>
<tr><td>1.</td><td>Current problems of Higher education, innovative and scientific-pedagogical activities</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
<tr><td>2.</td><td>Methodology of scientific and pedagogical research</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
<tr><td>3.</td><td>Information and communication technologies in scientific, pedagogical and innovative activities</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
<tr><td>4</td><td>Innovations in the History of Education as a Driving Factor of Development</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
<tr><td>5</td><td>Pedagogy and psychology of higher education</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
</table>
</td></tr>
</table>

		6	Management in Education	0-10	A report is prepared and a presentation is made
		7	Teacher's personal effectiveness	0-10	A report is prepared and a presentation is made
		8	Innovative approaches and technologies in education	0-10	A report is prepared and a presentation is made
		9	Socialization and education in the context of global challenges and risks	0-10	A report is prepared and a presentation is made
		10	Pedagogical skills and their formation	0-10	A report is prepared and a presentation is made
Recommended Literature	1. Магистрлик диссертацияларини тайёрлаш бўйича методик тавсиянома: магистратура бўлимининг барча мутахассисликлари учун мўлжалланган. – Т: ТДПУ, 2010. – 60 б. 2. Шермухамедова Н.А. Илмий тадқиқот методологияси. – Т.: “Fan va texnologiya”, 2014. – 512 б. 3. Алемасов В., Мамадалиев Ш. Илмий тадқиқот: методология, методика ва ижодиёт. – Т.: Ўзбекистон Республикаси ИИВ Академияси, 2015. – 102 б. 4. Ranjit Kumar. Research methodology a step-by-step guide for beginners. – Sage, New Delhi, 2011. – 415 p. 5. Саифназаров И., Никитченко Г.В., Б.У.Қосимов. Илмий ижод методологияси. – Т.: Янги аср авлоди, 2004. – 190 б. 6. Тўрақулов Х.А., Тўрақулов О.Х., Тўрақулов И.Х., Тўрақулов У.Х. Илмий тадқиқот асослари: 1000 саволга 1000 жавоб. – Т.: Fan va texnologiya, 2019. – 632 б.				

Discipline designation	**Research practice (gaining practical experience) (ECTS 30)**
Subject/module code	IA3410
Science taught semester (s).	4th semester
Teacher in charge	Abdullaev Elnur Akhmatovich, Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor. Anarboev Mukhiddin Almanovich, Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor. Nazarov Furkat Daminovich, Doctor of Philosophy (PhD) in Technical Sciences, senior teacher. Yuldashe Urishbay, Doctor of Physics and Mathematics, professor. Parsoxonov Abdulkobi Gafurovich, Candidate of Physical and Mathematical Sciences, Associate Professor.
Teaching language	Uzbek
Connection to the curriculum	Compulsory
Academic activities	Total hours: 300 hours
ECTS	10
Discipline objectives / Learning Outcomes	The purpose of the discipline is to prepare a master's student for independent research work, the main result of which is the writing and successful defense of a master's thesis. **Learning outcomes** - the ability to apply methods of scientific knowledge in independent research activities, generate and implement innovative ideas; - own the methodology of scientific knowledge, be able to analyze and evaluate the content and level of philosophical and methodological problems when solving problems of research and innovation activities; - designing and conducting comprehensive, systematic scientific research based on knowledge and skills in the field of energy, including innovative studies; - have the skills to use modern information technologies to solve research and innovation problems; - conducting scientific research activities in the field of energy using modern research methods and information and communication technologies; - adapt the results of modern energy and technical research to solve problems in the electric power system.
Lessons' contents	1. Data collection at the place of scientific practice (internship) for the research topic 2. Approval of a plan for research work, determination of specific volumes and directions of scientific; 3. Get to know the scientific internship program and calendar plan 4. Preparation of an analytical review of the literature on the research topic 5.Development of experimental methodology 6.Carrying out theoretical and experimental work on the research topic 7.Material testing

<table>
<tr><td></td><td>8.Presentation of practical research results at conferences
9.Development and justification of author’s proposals, principles, approaches, interpretations
10.Experimental testing</td></tr>
<tr><td>The exam format</td><td>Preparation of the report and its protection</td></tr>
<tr><td>Teaching/learning and examination requirements</td><td>No more than 3 days are allotted for drawing up the final report, during which masters put their individual plan in order, prepare written reports, and prepare presentations. Each masters submits the following materials:
- Report text;
- Individual plan and characteristics from the supervisor;
- Presentations of master's students-interns in electronic form.
The credit for research activities (practice) is accepted by the commission in accordance with the approved order, in the presence of all masters and their supervisors.
During the certification, the competencies of master's students-interns, which they mastered in the process of carrying out research activities (practice), are assessed.</td></tr>
<tr><td>CRITERIA for evaluating the tasks performed by students during their Master's degree scientific practice and research work and master's thesis preparation practice</td><td>
<table>
<tr><th>T/r</th><th>Name of events and tasks</th><th>Allocated points</th><th>Report form</th></tr>
<tr><td>1.</td><td>Collecting data from the organization of scientific practice (internship) on the research topic</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
<tr><td>2.</td><td>Approval of a plan for research work, determination of specific volumes and directions of scientific research (drawing up and approval of an individual work plan for a master’s student);</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
<tr><td>3.</td><td>Get to know the scientific internship program and calendar plan</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
<tr><td>4</td><td>Preparation of an analytical review of the literature on the research topic</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
<tr><td>5</td><td>Development of experimental methodology</td><td>0-10</td><td>A report is prepared and a presentation is made</td></tr>
</table>
</td></tr>
</table>

	6	Carrying out theoretical and experimental work on the research topic	0-10	A report is prepared and a presentation is made
	7	Material testing	0-10	A report is prepared and a presentation is made
	8	Presentation of theoretical research results at conferences	0-10	A report is prepared and a presentation is made
	9	Development and justification of author's proposals, principles, approaches, interpretations	0-10	A report is prepared and a presentation is made
	10	Experimental testing	0-10	A report is prepared and a presentation is made
	Note: 1. Assignments are prepared in handwritten form and are approved by the student with a signature on each page. 2. The assignment is prepared based on a prescribed sample and approved by the relevant authorities. 3. Completed assignments will not be evaluated if they do not meet the assessment criteria.			

Recommended Literature

Main literature:

1. Law of the Republic of Uzbekistan "On electric energy". Received June 24, 2009.

2. "On introducing amendments and additions to the Resolution 'On the approval of the rules for the preparation of doctoral dissertations and dissertation abstracts" Decision of the Presidium of the Higher Attestation Commission under the Cabinet of Ministers of the Republic of Uzbekistan, registered on June 23, 2017, registration number 2665-1.

3. State standard ISO 50001-2012. Energy management systems. National norm. Requirements and ISO 50001: 2011. Guidance on the application of energy management systems - Requirements with an Operation Guide (IDT).

4. O.O. Hoshimov. A.T. Imomnazarov. Elektr mexanik tizimlarda energiya tejamkorligi. Toshkent-2015. "Fan va texnologiya" nashriyoti.

5. Xoshimov O. Sanoat korxonalarining elektr jihozlari montaji, Toshkent,-2007.

6. Majidov. Noana'naviy va qayta tiklanuvchi energiya manbalari. Toshkent-2014.

7. M.A. Graña-López, A. García-Diez, A. Filgueira-Vizoso, J. Chouza-Gestoso and A. Masdías-Bonome. Study of the Sustainability of Electrical Power Systems: Analysis of the Causes that Generate Reactive Power. Sustainability 2019, 11, 7202; doi:10.3390/su11247202.

8. Raxmonov I.U. "Elektr ta'minoti asoslari". Darslik.

	Toshkent: 2019, 226 b. **Additional literature:** 1. Mirziyoyev Sh.M. Yangi O‘zbekistonda erkin va farovon yashaylik. –T.: “TASVIR nashriyot uyi”, – 2021.– 50 b. 2. Mirziyoyev Sh.M. Milliy taraqqiyot yo‘limizni qati’yat bilan davom ettirib yangi bosqichga ko‘taramiz .–T.:“O‘zbekiston”, 2017–592 b. 3. 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”. 4. 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”. 5. General Aspects of Energy Management And Energy Audit. Guide Book For National Certification Examination For Energy Auditors and Managers. 6. Xoshimov F.A., Taslimov A.D. Energiya tejamkorligi asoslari. O‘quv qo‘llanma. – T.: “Voris”, 2014 – 192 bet. 7. Аллаев К.Р., Хошимов Ф.А. Энергосбережение в промышленных предприятиях, Монография. – Т.:Fan. 2012. 8. Aripov N. M. Elektr stansiyalarning elektr jihozlari, Toshkent,-2005 **Internet resources:** www.lex.uz – National database of information on legal documents of the Republic of Uzbekistan. www.ziyonet.uz – national educational materials search site. www.gov.uz – Government portal of the Republic of Uzbekistan. www.google.com – international educational materials search site. www.energystrategy.ru – “Energy Policy and Strategy” information portal www.twirpx.com – international educational materials search site.