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/#