

| Name of subject                                       | Alternative energy sources (ECTS 8)  |
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| Subject/module code                                   | ETTMEM24508  |
| Science taught semester (s).                          | 4 <sup>th</sup> and 5 <sup>th</sup> semester   |
| Responsible teacher                                   | Suyarov Anvar Olimjon o'g'li   |
| Education language                                    | Uzbek  |
| Study to the program connection                       | Elective   |
| Training hours (this including independent education) | <b>Total hours-240.</b><br><b>Audience Training hours - 96.</b><br>Lecture training hour – 36<br>Practical training hour – 60<br><b>Independent education -144 hours</b>   |
| ECTS  | 8  |
| The purpose and tasks of subject / learning outcomes  | <p><b>The purpose of teaching the subject</b> is to develop an understanding of renewable energy sources in students, analyze the share of renewable energy sources in the world's electricity generation capacity, develop skills and qualifications in the classification and structural structure of the electric power industry, electricity generation processes, and the effective operation of electrical devices under specific operating conditions.</p> <p><b>The task of the subject</b> is to The role of the electric power industry in the rapid development of the economy is incomparable. Due to the stable operation of the energy system of Uzbekistan, the national economy is provided with uninterrupted and high-quality electric energy. This process, in turn, increases the demand for training highly qualified personnel.</p> <p>This program reflects the goals and objectives, content of the discipline “Alternative energy sources”.</p> <p>In-depth study of the science of Alternative energy sources plays an important role in solving the problems of the harmful effects of energy on the environment.</p> <p><b>Learning outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Studies the development, history, and prospects of renewable energy sources and the electric power system.</li> <li>2. The role and socio-economic significance of alternative energy in society.</li> <li>3. State policy in the energy sector and its development trends and prospects in the country and the world.</li> <li>4. Basic concepts in the electric power sector.</li> <li>5. Key performance indicators for various types of transport and opportunities for their improvement.</li> <li>6. Increasing the efficiency of electricity generation equipment.</li> <li>7. Economic assessment of the competitiveness of traditional and unconventional methods of electricity generation.</li> </ol> |
| Course content (topics)                               | <p><b>I. Main Theoretical Part (Lecture Sessions)</b></p> <p><b>Topic 1:</b> Introduction. Opportunities for the use of renewable energy sources. Analysis of the opportunities for the use of renewable energy sources in the energy system</p> <p><b>Topic 2:</b> Regulatory and legal framework for the use of renewable energy sources in the energy system of Uzbekistan.</p> <p>History of the development of the energy sector of Uzbekistan. Renewable energy sources, their types and resources. Prospects and stages of development of the use of renewable energy resources in the territory of Uzbekistan.</p> <p><b>Topic 3:</b> The role of renewable energy sources in the transition of the</p>  |

Republic of Uzbekistan to a "green" economy.

**Topic 4: Hydropower.**

Large natural and artificial subsystems that serve to convert the energy of water flows into electrical energy.

Hydropower plants, their types, principle of operation

**Topic 5:** Hydroelectric power plants and small hydroelectric power plants.

The principle and function of operation of hydroelectric power plants (HPP). HPP operating modes. Small hydroelectric power plants and their operating processes. Advantages of small hydroelectric power plants

**Topic 6: Solar thermal systems**

Conversion of sunlight energy into thermal energy of water. Flat-plate solar collectors. Use of solar thermal systems. Efficient use of solar energy. Parabolic trough solar power plants. High-temperature solar devices. Solar furnaces.

**Topic 7:** Conversion of solar energy into electrical energy.

Photoelectric effect phenomenon. Structural scheme of zones in semiconductors. p-n junction, layout schemes of p-n junctions in a semiconductor crystal. Volt-ampere classifications of semiconductor materials and solar photovoltaic panels. Solar photovoltaic power plants, Solar thermodynamic power plants

**Topic 8.** Wind power plants and power stations

Existing SHES in developed countries. Future prospects of SHES. Wind power plants. Wind energy resources map. Future prospects of wind power plants.

**Topic 9:** Selection and use of wind power equipment

Electric generators and their selection, selection of electric drives, selection of a place for installing a wind electric motor. Analysis of biomass energy resources and their use indicators.

**Topic 10:** Biomass energy sources and their use

General information about biomass sources. Processes of converting biomass into useful energy. Converting biomass into useful energy in thermal and chemical processes.

Modern bioenergy devices, their structure and principle of operation. Scheme of the working process of a biomass device. Methods of pyrolysis, alcohol production. Production of biogas using anaerobic digestion. Biomass energy resources resources.

**Topic 11:** Geothermal energy sources and their use

Use of geothermal energy. Types of geothermal power plants. Scales of geothermal energy use and their impact on the environment

Installation of hydrothermal power plants in hyperthermal areas. Scheme of heat recovery from dry rock. Heat source from hydrothermal resources.

**Topic 12:** Geothermal power plant using geothermal heat

Cycles for generating electricity from geothermal heat. Scheme of a geothermal power plant with a low boiling point. Geothermal power plant using natural steam directly.

**Topic 13:** Use of ocean wave energy

Ocean wave energy, reactive converters of ocean wave energy, hydroelectric power station on ocean wave energy.

**Topic 14:** Use of tidal energy of seas and oceans

Tidal energy of seas and oceans, wave energy device, wave power station, tidal power station scheme.

**Topic 15:** Environmental aspects of the use of renewable energy sources.

The impact of geothermal energy, solar power plants, wind power plants on the environment. The impact of small hydropower, hydroelectric power plants, biomass energy, ocean energy on the

environment.

## **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. Calculation and comparison of the economic efficiency of renewable energy power plants around the world.
2. Calculation of the parameters of a hydroelectric dam and a hydroturbine.
3. Study of the volt-ampere and volt-watt characteristics of a solar cell
4. Series connection of solar cells.
5. Parallel connection of solar cells.
6. Calculation and selection of a photovoltaic module for a solar power plant.
7. Calculation of the type and number of accumulator batteries.
8. Calculation of the prices of selected basic equipment for a solar power plant for an individual house.
9. Study of the structure and principle of operation of a vacuum tube solar collector.
10. Measurement of the parameters of water heated in a flat solar collector and determination of its thermal efficiency.
11. Calculation of a wind power plant. Selection and calculation of a wind power plant generator.
12. Calculation of the volume and heat of a biogas plant reactor.
13. Calculation of thermal power taking into account the use of geothermal heat.

## **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. The role and importance of renewable energy in the fuel and energy complex of Uzbekistan.
2. Prospects for the use of renewable energy in the energy sector of the world and Uzbekistan.
3. Trends in the development of renewable energy in Uzbekistan.
4. Use of solar energy in energy supply systems. Technical characteristics of solar installations. Climatic advantages for the construction of solar installations.
5. Main technical schemes of solar installations. Their technical and economic indicators.
6. Production of electricity as a result of the photovoltaic effect.
7. Heliothermal technology for converting solar energy.
8. Wind power. Main directions and technical characteristics of the development of wind power plants.
9. General characteristics and development directions of wind power in

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|                        | <p>Uzbekistan.</p> <p>10. Bioenergy. Main technical schemes of bioenergy plants.</p> <p>11. Main directions of the development of bioenergy in Uzbekistan.</p> <p>12. Technical, socio-economic and environmental problems in the system of waste processing technologies.</p> <p>13. Geothermal energy. The main technical and economic conditions for its development.</p> <p>14. Small hydropower plants. Prospects for the construction of small hydropower plants. General description of energy sources and the main technical solutions for their development.</p> <p>15. Energy of the seas and oceans. General description of energy potential and technical possibilities for its development.</p> <p>16. Wave and tidal devices. Basic technical characteristics, development prospects.</p> <p>17. Thermal energy of the seas and oceans. Energy of ocean currents.</p> <p>18. What problems can be solved in our country using renewable energy?</p> <p>19. Current status and prospects for the use of renewable energy sources.</p> <p>20. The role of small hydropower in the development of certain regions of Uzbekistan.</p> <p>21. The status of renewable energy in Uzbekistan, problems and solutions.</p> |
| Student assessment     | <p>Assessment of student knowledge is based on the mastery of the learning material during the semester and final control (tests, assignments, written and oral work results).</p> <p>During the course of Alternative energy sources, students are evaluated on a 100-point system. Of these, 50 points are allocated to the current and intermediate results (60% of 50 points are current control, independent study and 40% are intermediate control), and 50 points are allocated to the final control results. Students whose total score of current and intermediate points is less than 30 points are not admitted to the final control exam. A student who scores 30 or more points in the final control is considered to have mastered the subject.</p>  |
| Requirements for exams | <p>The student must have fully mastered the theoretical and practical concepts of the subject, be able to correctly reflect the results of the analysis. The student must have completed the tasks given in the current and intermediate forms of independent work, assessment. At the same time, he must have received the necessary points from the current, intermediate, independent education and final tests in the relevant subject within the specified time.</p> <p>A student who has not submitted current control, intermediate control and independent education tasks, as well as who has scored less than 30 points on these tasks and types of control, will not be included in the final type of control.</p> <p>Also, a student who has missed 25 or more percent of the classroom hours allocated to the subject without an excuse will be expelled from this subject, will not be allowed to take the final exam and will be considered as not having mastered the relevant credits in this subject.</p> <p>A student who fails the final exam or scores less than 30 points on this type of exam is considered academically indebted.</p>  |
| Recommended Literature | <p><b>Main literature:</b></p> <ol style="list-style-type: none"> <li>1. 21.05.2019 -yildagi “Qayta tiklanuvchi energiya manbalaridan foydalanish to‘g‘risida”gi O‘zbekiston Respublikasining Qonuni.</li> <li>2. O‘zbekiston Respublikasi Prezidentining 04.10.2019-yildagi “2019 — 2030-yillar davrida O‘zbekiston respublikasining “yashil” iqtisodiyotga o‘tish strategiyasini tasdiqlash to‘g‘risida”gi PQ-4477-sonli Qarori</li> <li>3. O‘zbekiston Respublikasi Prezidentining 26.05.2017-yildagi “2017-2021 yillarda qayta tiklanuvchi energetikani yanada</li> </ol>  |

rivojlantirish, iqtisodiyot tarmoqlari va ijtimoiy sohada energiya samaradorligini oshirish chora-tadbirlari dasturi to'g'risida"gi PQ-3012-sonli Qarori.

4. O'zbekiston Respublikasi Prezidentining 22.08.2019-yildagi "Iqtisodiyot tarmoqlari va ijtimoiy sohaning energiya samaradorligini oshirish, energiya tejovchi texnologiyalarni joriy etish va qayta tiklanuvchi energiya manbalarini rivojlantirishning tezkor chora-tadbirlari to'g'risida"gi PQ-4422-sonli Qarori.

5. Majidov T.Sh. Noan'anaviy va qayta tiklanuvchi energiya manbalari // Toshkent. 2014.

6. John Twidell and Tony Weir. Renewable Energy Resources // Taylor and Francis Group. LONDON AND NEW YORK, 2006.

7. Renewable Energy // ICAR e-Course For B.Sc (Agriculture) and B.Tech (Agriculture)

8. Риполь-Сарагоси Т.Л., Кууск А.Б. Возобновляемые и нетрадиционные источники энергии. Учебно-методическое пособие // Ростов-на-Дону, 2019. – 122 с.

9. Badalov A.S., Zenkova V.A., Uralov B.R., Shaazizov F.Sh. Hidroelektrostansiyalar. O'quv qo'llanma // Toshkent – 2009.

10. М.М. Мухаммадиев, Б.У. Уришев, Э.К. Мамадиёров, К.С. Джураев Энергетические установки малой мощности на базе возобновляемых источников энергии // Ташкент. ТашГТУ, 2015.- С.161

11. Faleev D.S Osnovnye karakteristiki solnechnykh moduley // Metodicheskaya ukazaniya. Xabarovsk. 2013. – Izdatelstvo DVGUPS. – S.28

12. Gremenok V.F., Tivanov M. S., Zaleski V.B Solar cells based semiconductor materials// International Scientific Journal for Alternative Energy and Ecology – 2009 – Vol.69. №1. – P. 59-124.

#### **Additional literature:**

13. Mirziyoev SH.M. Buyuk kelajagimizni mard va olijanob xalqimiz bilan birga quramiz. - T.: "O'zbekiston" NMIU, 2017. – 488 b.

14. O'zbekiston Respublikasini yanada rivojlantirish bo'yicha Harakatlar strategiyasi to'g'risida. - T.:2017 yil 7 fevral, PF-4947-sonli Farmoni.

15. O'zbekiston Respublikasini «Energiyadan ratsional foydalanish haqidagi» qonuni 29 aprel 1997yil.

Афанасев В. П., Теруков Э. И., Шерченков А. А Тонкопленочные солнечные элементы на основе кремния // Санкт-Петербург. Издательство СПбГЕТУ «ЛТИ» 2011

#### **Internet resources:**

13. [www.gov.uz](http://www.gov.uz) – O'zbekiston Respublikasining hukumat portali.

14. [www.ziyonet.uz](http://www.ziyonet.uz)– milliy o'quv materiallarining qidiruv sayti.

15. [www.lex.uz](http://www.lex.uz)– 'zbekiston Respublikasining Qonun hujjatlari ma'lumotlari milliy bazasi