**Nazwa przedmiotu:**

Advanced Renewable Energy Sources

**Koordynator przedmiotu:**

prof. dr hab. inż. Roman Domański

**Status przedmiotu:**

Fakultatywny ograniczonego wyboru

**Poziom kształcenia:**

Studia II stopnia

**Program:**

Robotics

**Grupa przedmiotów:**

Przedmioty obieralne

**Kod przedmiotu:**

ANS534

**Semestr nominalny:**

3 / rok ak. 2020/2021

**Liczba punktów ECTS:**

3

**Liczba godzin pracy studenta związanych z osiągnięciem efektów uczenia się:**

1) Number of hours thatrequire the presence of a teacher - 47, including:
a) attendanceat the lectures - 30hours;
b) attendanceat the exercises- 15hours;
c) consultancymeetings – 2 hours.
2) The number of hours of independent work of student: 10 hours for completion of homeworkproject.

**Liczba punktów ECTS na zajęciach wymagających bezpośredniego udziału nauczycieli akademickich:**

2 ECTS credits– number of hours that require the presence of a teacher – 47, including:
a) attendanceat the lectures - 30hours;
b) attendanceat the exercises – 15 hours;
e) consultancymeetings – 2 hours.

**Język prowadzenia zajęć:**

angielski

**Liczba punktów ECTS, którą student uzyskuje w ramach zajęć o charakterze praktycznym:**

**Formy zajęć i ich wymiar w semestrze:**

|  |  |
| --- | --- |
| Wykład: | 30h |
| Ćwiczenia: | 15h |
| Laboratorium: | 0h |
| Projekt: | 0h |
| Lekcje komputerowe: | 0h |

**Wymagania wstępne:**

Knowledge of different energy sources and conversion methods.
Knowledge of basic thermodynamics (Thermodynamics I or equivalent).
Understanding of operating principles of essential types of energy conversion equipment: boilers, turbines, nuclear reactors, wind turbines, water turbines, photovoltaic cells.

**Limit liczby studentów:**

100

**Cel przedmiotu:**

Upon completion of the course students will have:
• understanding of capabilities and limitations of individual renewable energy types and renewable energy sector as a whole,
• ability to evaluate potential of renewable energy sources at a specific region,
• ability to identify challenges related to integration of renewable energy sources in a larger energy system and propose potential solutions to these challenges,
• basic understanding of direct and indirect costs related to renewable energy utilisation.

**Treści kształcenia:**

Lecture:
• Basic terminology related to energy conversion processes. World’s energy resources (fossil fuel and nuclear)versus renewable energy sources.
• The basic parameters for energy storage.
• Energy conversionefficiency for selected processes and devices. Possibility of energy storage.
• Renewable sources; sun as an energy source, conversion of solar radiation energy (collectors and photovoltaic systems).
• Solarsystems for heating and hot water production. Biomass and biofuels – in energy and transportationsector. Solar power plants. Solar energy for heating and hot water generation.
• Wind energy and windpower generation.
• Energy of waters and oceans (tidal and wave energy conversion), OTEC.
• Geothermy –geothermal systems, prospective hot dry rock technologies. Heat pump. Geothermy in Poland.
• Hydrogen as an energy carrier, hydrogen production by renewables.
• Examples of renewable energy conversionsystems for heat and power generation. Place for renewable in world energy scenario.
• Prospectivepower generation technologies using the renewables. Typical solutions of waste utilisation used inpower engineering.
• Rationalization of energy consumption, increase of energy conversion efficiencies.
• Environmental footprint of renewable technologies.
• Integration of renewable power generation systems with the grid.
Exercises:
• Calculations of actual cost of renewable electricity generation.
• Calculations of required system reserves for compensating imbalance caused by renewable systems.
• Comparisons of capacity factors for different technologies and different areas of the world.
• Calculations of maximum share of renewables for different conditions.

**Metody oceny:**

The final mark will be given as a weighted average of two components:
• 60% of a multiple-choice final test,
• 40% of a homework project.
The project will be made in teams of several students with individually assigned subjects.

**Egzamin:**

tak

**Literatura:**

1. IEA World Energy Outlook (currentedition).
2. Duffie J.A., Beckman W.A.: Solar Engineering of ThermalProcesses, John Willey&Sons, 2006.
3. Klimstra J., Power SupplyChallenges, Vaasa 2014.

**Witryna www przedmiotu:**

**Uwagi:**

## Charakterystyki przedmiotowe

### Profil ogólnoakademicki - wiedza

**Charakterystyka ANS534\_W1:**

Students should understand advantages and disadvantages of various renewable energy systems and should be familiar with the trends observable in renewable energy sector.

Weryfikacja:

Final test.

**Powiązane charakterystyki kierunkowe:** AiR2\_W02

**Powiązane charakterystyki obszarowe:** III.P7S\_WG.o, P7U\_W, I.P7S\_WG

**Charakterystyka ANS534\_W2:**

Students should be aware of direct and indirect costs associated with renewable energy intake.

Weryfikacja:

Final test.

**Powiązane charakterystyki kierunkowe:** AiR2\_W02

**Powiązane charakterystyki obszarowe:** I.P7S\_WG, III.P7S\_WG.o, P7U\_W

### Profil ogólnoakademicki - umiejętności

**Charakterystyka ANS534\_U1:**

Students should be able to analyze a potential to apply a renewable energy system in a specific region.

Weryfikacja:

Final test and homework project.

**Powiązane charakterystyki kierunkowe:** AiR2\_U01, AiR2\_U18, AiR2\_U19

**Powiązane charakterystyki obszarowe:** P7U\_U, I.P7S\_UW.o, III.P7S\_UW.o, I.P7S\_UW, III.P7S\_UW.1.o, III.P7S\_UW.3.o, I.P7S\_UO

**Charakterystyka ANS534\_U2:**

Students should be able to identify challenges associated with integration of renewable energy sources in the framework of a larger energy system and should be able to solve the emergent technical problems.

Weryfikacja:

Final test and homework project.

**Powiązane charakterystyki kierunkowe:** AiR2\_U01, AiR2\_U18, AiR2\_U19

**Powiązane charakterystyki obszarowe:** P7U\_U, I.P7S\_UW.o, III.P7S\_UW.o, I.P7S\_UW, III.P7S\_UW.1.o, III.P7S\_UW.3.o, I.P7S\_UO