

Course syllabus

binding for the doctoral students of the CUT Doctoral School commencing their studies
in the academic year 2022/2023

Information on the course

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| Name of the course in Polish | Energetyka Odnawialna |
| Name of the course in English | Renewable Energy |
| Number of the ECTS points | 1 |
| Language of instruction | Polish |
| Category of the course | Elective |
| Field of education | Engineering and Technology |
| Discipline of education | Environmental engineering, ,mining and power engineering |
| Person responsible for the course Contact | Prof. Sławomir Grądział, <i>doctor hab.</i> , MSc in Eng. , professor of CUT slawomir.gradziel@pk.edu.pl |

Type of course, number of hours in the study programme curriculum

| Semester | Credit type (G / NG)* | Lecture | Practical class | Laboratory | Computer Laboratory | Project class | Seminar |
|------------------|--------------------------|---------|--------------------|------------|------------------------|------------------|---------|
| 2, 3, 4, 5, 6 | G | 15 | 0 | 0 | 0 | 0 | 0 |

*G – graded credit, NG – non-graded credit

Course objectives

| Code | Objective description |
|-------------|---|
| Objective 1 | Expanding knowledge on the use of renewable energy sources to generate electricity and heat |
| Objective 2 | Acquiring the ability to select appropriate devices producing electricity and heat |

Learning Outcomes

| Code | Description of the learning outcome adjusted to the specific characteristics of the discipline | Learning outcome symbol in the CUT SD | Methods of verification |
|-------------------------------|--|---------------------------------------|--|
| OUTCOMES RELATED TO KNOWLEDGE | | | |
| EUW1 | The doctoral student knows the principles of construction, operation, design and modelling of installations using alternative energy sources | E_W01 E_W02 | Involvement in class activities, presentations |
| EUW2 | The doctoral student knows and understands the principles of selecting devices that generate electricity and heat | E_W01 E_W02 | Involvement in class activities, presentation |
| OUTCOMES RELATED TO SKILLS | | | |
| EUU1 | The doctoral student is able to test a flat liquid solar collector in order to determine its efficiency. | E_U01 | Graded presentation |

| | | | |
|---|---|----------------|------------|
| EUU2 | The doctoral student is able to select the appropriate device for generating electricity and heat and to correctly analyse and evaluate these devices | E_U01 | Discussion |
| OUTCOMES RELATED TO SOCIAL COMPETENCES | | | |
| EUK1 | The doctoral student is prepared to recognize the importance of knowledge of the design and modelling of installations using renewable energy sources | E_K03 E_K01 | Discussion |

Course outline

| No. | Contents | Learning outcomes for the course | No. of hours |
|----------------|---|----------------------------------|--------------|
| LECTURE | | | |
| W1 | Development of renewable energy. The world energy situation. Renewable energy resources. Comparison of economic and social effects of using various renewable energy sources. | EUW1 | 1 |
| W2 | Water energy. Basic types of hydropower plants. Construction and operation of water turbines. Selection of a water turbine. | EUW1, EUW2, EUU2, EUK1 | 2 |
| W3 | Wind energy. Influence of wind farms on the power system. The use of offshore wind energy. Modelling of wind turbines with horizontal and vertical axis of rotation. | EUW1, EUW2, EUU2, EUK1 | 1 |
| W4 | Solar power plants. The method of determining the solar constant. Active and passive ways to use the energy of the sun. Solar cells. | EUW1, EUW2, EUU1, EUU2, EUK1 | 1 |
| W5 | Construction and operation of a heat pump. Thermodynamic cycle in the heat pump. Selection of heat pumps. Types of ground sources for heat pumps. Methods of selecting horizontal and vertical ground probes. | EUW1, EUW2, EUU2, EUK1 | 2 |
| W6 | Hybrid systems in central heating installations using renewable energy sources | EUW1, EUW2, EUU2, EUK1 | 2 |

The ECTS points statement

| WORKING HOURS SETTLEMENT | |
|---|---|
| Type of activity | Average number of hours (45 min.) dedicated to the completion of an activity type |
| SCHEDULED CONTACT HOURS WITH THE ACADEMIC TEACHER | |
| Hours allotted in the syllabus | 15 |
| Consultations | 1 |
| Examination / course credit assignment | 2 |
| HOURS WITHOUT THE PARTICIPATION OF THE ACADEMIC TEACHER | |
| Independent study of the course contents | 8 |
| Preparation of a paper, report, project, presentation, discussion | 5 |
| ECTS POINTS STATEMENT | |

| | |
|------------------------|----|
| Total number of hours | 30 |
| The ECTS points number | 1 |

Preliminary requirements

| No. | Requirements |
|-----|----------------------------------|
| 1 | Basic knowledge of heat transfer |

Course credit assignment conditions / method of the final grade calculation

| No. | Description |
|---------------------------------------|---|
| COURSE CREDIT ASSIGNMENT CONDITIONS | |
| 1 | 75% attendance in class. |
| 2 | Delivery of an oral presentation on a selected topic. |
| METHOD OF THE FINAL GRADE CALCULATION | |
| | Credit assigned on the grounds of the delivery of the presentation and attendance in class. |

Additional information

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| None |
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The course reading list

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|---|--|
| 1 | Lewandowski W.M., Pro-ecological renewable energy sources, Warsaw, 2012, WNT |
| 2 | Taler D., Rup K., Fundamentals of wind and water turbine calculations, Warsaw, 2021, PWN |
| 3 | Klugman-Radziemska E., Renewable energy sources. Computational examples, Gdańsk, 2009, Gdańsk University of Technology |
| 4 | Nantka M.B., Heating and heat engineering, Gliwice, 2010, Publishing House of the Silesian University of Technology |
| 5 | Kavanaugh S., Rafferty K., Geothermal Heating and Cooling. Design of Ground-Source. Heat Pump Systems., Atlanta, USA, 2014, ASHRAE |