

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 | Magazynowanie energii |
| Name of the course in English | Energy storage |
| 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 Paweł Ocloń, <i>doctor hab.</i> , MSc in Eng. pawel.oclon@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 |
|----------|--------------------------|---------|--------------------|------------|------------------------|------------------|---------|
| 3 | G | 15 | 0 | 0 | 0 | 0 | 0 |

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

Course objectives

| Code | Objective description |
|-------------|--|
| Objective 1 | Introduction to the methods of electrical energy storage |
| Objective 2 | Introduction to the methods of thermal energy storage |

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 has the knowledge electrical and thermal energy storage techniques | E_W01 E_W02 | |
| OUTCOMES RELATED TO SKILLS | | | |
| EUU1 | The doctoral student is able to design an electrical energy storage system | E_U01 | |
| EUU2 | The doctoral student is able to design a thermal energy storage system | E_U02 | |
| OUTCOMES RELATED TO SOCIAL COMPETENCES | | | |
| EUK1 | The doctoral student is able to work in a team to solve engineering problems | E_K01 | Discussion |

Course outline

| No. | Contents | Learning outcomes for the course | No. of hours |
|----------------|--|----------------------------------|--------------|
| LECTURE | | | |
| W1 | Overview of the issues of integration of renewable energy sources with conventional systems. Discussion of Poland's energy problems in the context of increasing the share of renewable energy sources in the national energy system | EUW1, EUW2, EUU1 | 5 |
| W2 | Overview of electricity storage methods (hydrogen technologies, gas-liquid systems, compressed air energy storage). | EUW1, EUW2 | 5 |
| W3 | Overview of thermal energy storage methods (phase-change materials, accumulation tanks, underground storage of thermal energy) | EUW1, EUU2, EUK1, | 5 |

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 | 4 |
| ECTS POINTS STATEMENT | |
| Total number of hours | 30 |
| The ECTS points number | 1 |

Preliminary requirements

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

Course credit assignment conditions / method of the final grade calculation

| No. | Description |
|--|--|
| COURSE CREDIT ASSIGNMENT CONDITIONS | |
| 1 | Project on numerical calculations of temperature distribution in an underground energy store system |
| METHOD OF THE FINAL GRADE CALCULATION | |
| | Credit assigned on the grounds of the results of the project on numerical calculations of temperature distribution in an underground energy store system |

Additional information

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| None |
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The course reading list

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| 1 | Robert A.Huggins — Energy Storage, New York, USA, 2010, Springer |
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| 2 | Paweł Ochoń, Renewable Energy Utilization Using Underground Energy Systems Lecture Notes in Energy, Vol. 84, Springer International Publishing, 2021, Cham, Switzerland |
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