COURSE DESCRIPTION CARD - SYLLABUS

Course name

Thermokinetic processes in renewable energy conversion

Course

Field of study

Power Engineering

Year/Semester

1/2

Area of study (specialization)

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

15

Laboratory classes

15

Other (e.g. online)

Tutorials

Projects/seminars

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

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Responsible for the course/lecturer:

Prerequisites

A student starting classes on this subject must have basic knowledge in mathematics, physics and electrotechnics. Students should have the ability to effectively self-study in a field related to the chosen field of study. In addition, he is aware of the need to expand his competences, readiness to cooperate within the team.

Course objective

Studnet systematizes knowledge about the types of energy occurring in industry, by the means of their conversion into other forms of useful energy. Studnet will learn how to transport heat and measure

temperature. You will learn the basics describing heat exchange in typical thermokinetic systems and electrothermal devices.

Course-related learning outcomes

Knowledge

The student has expanded knowledge about the ways and ways of heat transfer, heat transformations occurring in electrical and electrothermal, and selected non-electrical quantities, in particular temperature measurements important for operational reasons, temperature measurement methods.

Studnet has detailed and theoretically founded knowledge of the principles of construction, modeling, life cycle processes of energy system elements; knows the main development trends of these systems. In addition, he has ordered and in-depth knowledge of methods for analyzing selected phenomena in electromagnetic transducers, and in particular the restrictions resulting from thermal restrictions for devices used in power engineering.

Skills

The student has the ability to obtain information from literature, databases and other sources regarding the material parameters of which particular elements of thermal systems are made. He is able to interpret, evaluate, critically analyze and synthesize with the determination of semi-optimal solutions under specific structural assumptions. He is also characterized by the ability to draw conclusions, as well as to formulate and comprehensively justify opinions on heating methods and ways of removing excessive heat energy from energy devices.

Studnet has the ability to work individually and in a team, is able to manage the team in a way that ensures the implementation of the task of determining the thermal energy generated in the system of its discharge routes in the set time. The student is able to determine the directions of further learning and organize the process of self-education.

Studnet is able to assess the usefulness of methods and tools used in measurements, diagnostics and decision support related to energy processes. Especially in the field of modeling and analysis of heat energy flow performed using SolidWorks.

Social competences

The student understands and is ready for critical assessment and analysis of issues and recognizes the importance of knowledge in solving cognitive and practical problems in the field of energy with particular regard to thermal issues in energy.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during lectures is checked by a final test carried out at the end of the semester, in addition based on individual activity during classes, diligence and accuracy in the performance of assigned tasks, scoring on the final test (14 weeks of classes).

Knowledge and skills acquired during laboratory classes are assessed by the assessment of reports made individually and in groups during the presentation of laboratory results.

Programme content

LECTURES

- multimedia lecture using transparencies presenting characteristics and drawings describing Earth's primary energies, sources and volumes of renewable and non-renewable energy resources, as well as the paths of their production and processing.

- presenting and initiating discussions on energy balance of the thermokinetic system Earth - Sun - Moon - Space, the amount of energy reaching the Earth's surface and its paths

- taking into account economic and ecological aspects in the possibility of obtaining energy from earth's primary energies with particular emphasis on renewable energies

- Presentation of knowledge in the field of energy conversion in conjunction with knowledge already possessed by students in the field of energy production - especially the efficiency of power plants and combined heat and power plants

- Discussion of electrothermal methods including the possibility of their use in industrial conditions, the generation of electromagnetic heat losses, useful heat,

- Discussion based on real systems of the basics of thermokinetics, heat conduction, convective heat transfer

- Discussion of the admissible temperatures occurring in electrical devices, temperature distribution in the heating circuit of devices, discussion on the occurring volumetric limits of the power that can be transmitted and released in the executive elements of heat-generating devices.

- Presentation of measuring instruments - electric thermometry used to measure temperature with particular emphasis on industrial equipment.

LABORATORY CLASSES

- getting to know the possibilities and making measurements using various measuring devices - thermocouples, resistance thermometers, pyrometers.

- discussion on the values obtained during measurements, analysis of differences in indications and the reasons for their occurrence

- measurements of electrical power absorbed by electrothermal devices and total useful power reaching the charge. Determining the efficiency of tested devices. Discussion on energy flow paths in tested devices, relative quantities of thermal start and possibilities of their limitation in practical terms

- measurements and determination of the efficiency of monochromatic electrical energy conversion into microwave energy, team work on developing preliminary measurement results during classes,

- based on the above-mentioned calculations, during class presentations in the form of graphs of power volume distribution, device efficiency,

- inference by students on unevenness of the field distribution in the resonance cavity and the consequences associated with it when heating charges.

- introduction of issues regarding the use of a thermal imaging camera and its use during laboratory classes

- illustrating the results obtained also by making an infrared photograph which the student attaches to the report and interprets

- entering the results of the power volume distribution based on the results of heat exchange modeling from the SolidWorks program

The presented program contents and implemented laboratory classes are based on the results of scientific research carried out at the Department.

Teaching methods

lectures:

- lecture with multimedia presentation (including drawings, photos, animations, sound, films) supplemented with examples given on the board

- lecture conducted in an interactive way with the formulation of questions to a group of students or to specific students indicated

- students' activity during classes is taken into account when issuing the final grade

- initiating discussions during the lecture

- theory presented in close connection with practice

- theory presented in relation to the current knowledge of students

- taking into account various aspects of the issues presented, including: economic

laboratories:

- laboratories supplemented with multimedia presentations (photos, animations, charts)

- use of tools enabling students to perform tasks at home (proprietary software)

- computational experiments

- teamwork

Bibliography

Basic

1. Hauser J.: Elektrotechnika. Podstawy elektrotermii i techniki świetlnej. Wydawnictwo Politechniki Poznańskiej, Poznań 2006

2. Michalski L., Eckersdorf K., Kucharski J.: Termometria. Przyrządy i pomiary. Wydawnictwo Politechniki Łódzkiej, Łódź 1998

3. Hering M.: Podstawy elektrotermii cz. I. WNT, Warszawa 1992.

4. Hering M.: Podstawy elektrotermii cz. II. WNT, Warszawa 1998

5. Hauser J.: Podstawy elektrotermicznego przetwarzania energii ZWK.D 1996

6. Materials for laboratory classes available on lumen.iee.put.poznan.pl and Moodle platform

Additional

1. Pluta Z.: Podstawy teoretyczne fototermicznej konwersji energii słonecznej, PW 2013

Breakdown of average student's workload

	Hours	ECTS
Total workload	64	2,0
Classes requiring direct contact with the teacher	33	1
Student's own work (literature studies, preparation for laboratory classes, preparation for test) [1]	31	1,0

[1] delete or add other activities as appropriate