STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Thermokinetic processes in renewable energy conversion	**1010315431010305650**

Field of study	Profile of study (general academic, practical)	Year /Semester
Power Engineering	**general academic**	**2 / 3**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Industrial Thermal Power Engineering	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**part-time**

No. of hours					No. of credits
Lecture: **8**	Classes: **-**	Laboratory: **8**	Project/seminars: **-**		**2**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
other	**university-wide**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**2 100%**
Technical sciences	**2 100%**

Responsible for subject / lecturer:

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Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Basic knowledge in mathematics, physics and electrical engineering.
2	**Skills**	Ability of effective self-education in the field connected with the chosen field of study.
3	**Social competencies**	He is aware of the need to broaden his competence, readiness to cooperate within the team

Assumptions and objectives of the course:

- Systematization of knowledge about the types of energy present in industry, ways of converting them into other forms of useful energy
- Know how to transport heat and measure temperature
- Understanding the basics of heat exchange in typical thermokinetic systems and electrothermal devices.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Knowledge of energy balance in industry - [K_W07+]
2. Familiarity with the processes and methods of electrical heating occurring in the industry - [K_W04+]
3. Has basic knowledge of the ways and ways of transferring heat, electrical transformations occurring in electrical engineering and electrothermics, and methods of measuring temperature - [K_W12+++]

Skills:

1. Describe the earthly primary energies, evaluate the significance of the individual energy flow channels - [K_U01++]
2. Calculate and evaluate the efficiency of the electricity conversion into energy - [K_U09+]
3. Solving a problem problem on the occurrence of heat losses and useful energy - [K_U03+]

Social competencies:

1. He can work in a group. He can share and coordinate work between team members - [K_K01++,]

Assessment methods of study outcomes

Lecture: Assessment of knowledge presented at the written test in the 14th week of classes

Laboratory classes: assessment of knowledge and skills related to the implementation of the exercise task, individual assessment of the basis of involvement in the exercise and discussion of n.t. obtained results of the measurements, the diligence and the quality of the presented multimedia presentations (including the preparation) from the laboratory exercises.

Course description

LECTURES

- a multimedia lecture with slides presenting characteristics and drawings describing earthly primary energies, sources and quantities of renewable and non-renewable energy resources and their production and processing paths.

- presenting and initiating discussion. Earth - Sun - Moon - Space, the amount of energy reaching the Earth's pile and the flow of its energy

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

- Presentation of knowledge in the field of energy conversion in connection with the students already know from the field of energy production - especially the efficiency of power plants and thermal power plants

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

- Discussion based on real systems of the basis of thermokinetics, heat conduction, convection of heat transfer

- Discussion of permissible temperatures in electrical equipment, temperature distributions in the heating circuit of equipment, discussion of the potential volume voltages that can be transmitted and dissipated in the actuators of electrical appliances.

- Presentation of measuring instruments - electrical thermometers for temperature measurement with special regard to industrial equipment.

LABORATORY CLASSES

- get acquainted with the possibilities and make measurements using various measuring devices - thermocouples, resistors, pyrometers.

- discussion of the values ??obtained during measurements, analysis of differences in indications and causes of their occurrence

- execution of measurements of electric power taken by electrothermal devices and total useful power reaching the charge. Determination of the efficiency of the tested devices. Discussion on energy flow paths in studied devices, relative values ??of thermal start and possibilities of their limitation in practical terms

- measurements and determination of the efficiency of converting monochromatic electricity to microwave energy, working in the team to develop preliminary results of measurements,

- on the basis of the above calculations, presenting during the classes in the form of graphs of volume distributions of power, efficiency of the device,

- inference by students n.t. Uneven distribution of the field in the resonant cavity and consequent consequences associated with the heating of the charge.

Applied methods of education: lectures:

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

- an interactive lecture with questions to a group of students or to specific students

- Student activity is taken into account during the final assessment

- during the lecture, initiating the discussion

- theory presented in close connection with practice

- theory presented in connection with current knowledge of students

- consideration of various aspects of the presented issues, including: economic ones

Applied methods of education: laboratories:

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

- use of tools to enable students to perform tasks at home (author software)

- computational experiments

- work in teams

Updated 2017:

- introducing issues related to the use of the thermal imager and its use during laboratory classes

- visualizing the results obtained also by making an infrared photo that the student attaches to the report and interprets.

Presented program content and laboratory activities are based on the results of scientific research conducted at the Institute.

Basic bibliography:

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. Materiały do zajęć laboratoryjnych dostępne na stronie lumen.iee.put.poznan.pl
7. Hauser J.: Elektrotechnika. Podstawy elektrotermii i techniki świetlnej. Wydawnictwo Politechniki Poznańskiej, Poznań 2006
8. Michalski L.: Eckersdorf K., Kucharski J.: Termometria. Przyrządy i pomiary. Wydawnictwo Politechniki Łódzkiej, Łódź 1998
9. Hering M.: Podstawy elektrotermii cz. I. WNT, Warszawa 1992.
10. Hering M.: Podstawy elektrotermii cz. II. WNT, Warszawa 1998
11. Hauser J.: Podstawy elektrotermicznego przetwarzania energii ZWK.D 1996
12. Materiały do zajęć laboratoryjnych dostępne na stronie lumen.iee.put.poznan.pl

Additional bibliography:

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

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	15
2. Participation in laboratory classes	15
3. Participation in consultations (lectures)	7
4. Participation in consultations (laboratory classes)	4
5. preparation for laboratory classes (home activites)	8
6. preparation reports to laboratory classes (homework)	8
7. preparation for the exam	5
8. participation in the final exam	2

Student's workload

Source of workload	hours	ECTS
Total workload	64	2
Contact hours	43	1
Practical activities	31	1