COURSE DESCRIPTION CARD - SYLLABUS

Course name
Heat exchange [S2ZE1E>WC]

Course

Field of study
Green Energy

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Knowledge: Basics of mathematics and physics mastered within the scope of the study program. Basic knowledge of thermodynamics and fluid mechanics. Skills: The student is able to describe the basic physical phenomena including thermodynamics and fluid mechanics and perform calculations related to them. Social competences: The student is able to define important priorities in solving the tasks set before him. The student shows independence in solving problems, acquiring and improving the acquired knowledge and skills.

Course objective

Mastering the ability to analyze phenomena related to the transport of mass, momentum and energy. Acquisition of the ability to design and modernize thermal-flow devices.

Course-related learning outcomes

Knowledge:
The student has extensive knowledge of the latest scientific discoveries in the field of thermodynamics, fluid mechanics, heat transfer, combustion processes, technical mechanics and strength of materials.
The student has knowledge of the operation and use of machines and devices for the generation,

processing and transformation of energy.

Skills:
The student is able to carry out measurements and analyzes of the condition of power machines and devices, taking into account unusual and unpredictable conditions of their operation. The student is able, using appropriate methods and tools, including advanced software, as well as information and communication techniques (ICT) and design techniques (CAD), to design, analyze and optimize the operation of machines, devices, energy systems and their components, ensuring their appropriate efficiency, efficiency and reliability. The student is able to apply and modify mathematical models in the analysis and design of processes, devices and energy systems in the states of normal and emergency operation of the energy system.

Social competences:
Prawidłowo identyfikuje i rozstrzyga dylematy związane z szeroko pojętym bezpieczeń-stwem energetycznym; potrafi myśleć i działać w sposób kreatywny i przedsiębiorczy; rozumie potrzebę działań na rzecz uświadamiania społeczeństwa o rozwoju proekolo-gicznych rozwiązań w zakresie energetyki i ochrony środowiska, ale także ograniczania zagrożeń jakie one niosą.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Verification of learning outcomes depending on the form of classes:
- lecture: written credit during the last classes of the semester, make-up date in the exam session,
- passing the accounting exercises is done through a full-semester activity assessment and one or two written tests, a make-up test during the examination session,
- passing the laboratory exercises is obtained on the basis of the verification of the knowledge in the area of the topic and the performed research report.

Programme content

The classes will include: the basics of thermodynamics and fluid mechanics, in part applicable to the issues of heat transfer. The program content will cover the issues of heat conduction, heat transfer by forced and natural convection and thermal radiation. All three basic topics will be discussed in relation to stationary and non-stationary problems, for laminar and turbulent flows.

Course topics

Laws and principles applicable to heat transfer. Applied methods of describing quantities characterizing heat transfer and relating to various thermodynamic schools. Basic laws describing the process of conduction, transfer and radiation of heat. The phenomenon of heat transfer and mass diffusion. The equation describing heat transfer in solids and fluids and its forms. Conditions for solving the energy balance equation. Description of heat transfer on selected geometric shapes appropriate to the field of study. Laminar and turbulent heat transfer conditions. Heat exchangers, heating nodes and heating networks - construction, principle of operation, design.

Teaching methods

Lectures in a stationary or remote form, depending on the appropriate order of the Rector of PP. Accounting exercises are held stationary and include solving detailed tasks and the implementation of the heat exchanger project carried out as part of the exercises. Laboratory classes are held in a full-time form within the prepared research and teaching positions of the Faculty of Environmental and Power Engineering.

Bibliography

Basic:
1. R.K. Rayput, Engineering Thermodynamics third edition, Laxmi Publications Ltd., 955 pages, 2019, ISBN-10:9380298404
2. Munson B.R., Rothmayer A.P., Okiishi T.H., Huebsch W.W., Fundamentals of Fluid Mechanics 7th Edition, Wiley, 2022, ISBN-10:1118116135
3. A Heat Transfer Textbook: Fifth Edition, Lienhard J., Dover Publications Inc., p. 784, 2020,

ISBN:100486837351
4. Cengel Y.H., Ghajar D.J., Heat And Mass Tranfer: Fundamentals & Applications, 5-th Edition, Published by McGraw-Hill Education, 2003, ISBN:978-0-07-339818-1

Additional:
1. Puzyrewski R., Sawicki J., Podstawy mechaniki płynów i hydrauliki, PWN, Warszaw 2013, ISBN:9788301173272 (in polish)
2. Wrzesiński Z., Termodynamika, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2016, ISBN:9788378145059 (in polish)
3. Wiśniewski S., Wiśniewski T.S., Wymiana ciepła, PWN, Warszawa 2019, ISBN:978-83-01-19443-7 (in polish)

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50