



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Heat exchange

### Course

Field of study

Year/Semester

Green energy

1/2

Area of study (specialization)

Profile of study

-

general academic

Level of study

Course offered in

Second-cycle studies

english

Form of study

Requirements

full-time

compulsory

### Number of hours

Lecture

Laboratory classes

Other (e.g. online)

15

15

0

Tutorials

Projects/seminars

30

0

### Number of credit points

4

### Lecturers

Responsible for the course/lecturer:

Responsible for the course/lecturer:

dr hab. inż. Jarosław Bartoszewicz, prof. PP

WIŚiE, Instytut Elektroenergetyki, Zakład  
Elektrowni i Gospodarki Elektroenergetycznej

jaroslaw.bartoszewicz@put.poznan.pl

### 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 bezpieczeństwem energetycznym; potrafi myśleć i działać w sposób kreatywny i przedsiębiorczy; rozumie potrzebę działań na rzecz uświadamiania społeczeństwa o rozwoju proekologicznych 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

Lectures, exercises and laboratories will cover: 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.

## 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, Warszawa 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	4,0
Classes requiring direct contact with the teacher	60	2,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam) <sup>1</sup>	40	1,5

<sup>1</sup> delete or add other activities as appropriate