

Cracow University of Technology

## 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

Name of the course in Polish	Wymiana ciepła i masy
Name of the course in English	Heat and mass exchange
Number of the ECTS points	1
Language of instruction	Polish
Category of the course	Choosable
Field of education	Engineering and technology
Discipline of education	Mechanical engineering
Person responsible for the course Contact	Prof. Beata Niezgoda-Żelasko, <i>doctor habilitatus</i> beata.niezgoda-zelasko@pk.edu.pl

### Type of course, number of hours in the study programme curriculum

Semester	Credit type (G / NG)*	Lecture	Practical classes	Laboratory	Computer Lab	Project Class	Seminar
2, 3, 4, 5	G	15	0	0	0	0	0

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

### Course objectives

Code	Objective description
Objective 1	Identifying the heat and mass transfer problems occurring in technology.
Objective 2	Understanding the computational techniques related to heat and mass transfer.

### Learning outcomes

Code	Description of the learning outcome adjusted to the specific characteristics of the discipline	Learning outcome symbol in the CUD DS	Methods of verification
<b>OUTCOMES RELATED TO KNOWLEDGE</b>			
EUW1	The doctoral student knows the laws governing the flow of heat and mathematical models of thermal phenomena characteristic for technical issues.	E_W01, E_W02	Involvement in class activities, an assessed presentation of a paper.
EUW2	The doctoral student knows the laws governing mass transfer and mathematical models characteristic of mass transfer processes in mechanical engineering.	E_W01, E_W02	Involvement in class activities, an assessed presentation of a paper.

EUW3	The doctoral student knows the computational methods used in the analysis of problems related to heat flow and mass transfer in the construction of machines and heat exchangers.	E_W01, E_W02	Involvement in class activities, an assessed presentation of a paper.
<b>OUTCOMES RELATED TO SKILLS</b>			
EUU1	The doctoral student is able to mathematically describe the phenomena of heat and mass flow occurring in engineering problems typical for mechanical engineering (heat exchangers, structural elements of machines, building construction objects).	E_U01	An assessed presentation of a paper.
EUU2	The doctoral student can perform thermal design calculations of selected types of heat exchangers, taking into account the mass transfer processes.	E_U01	An assessed presentation of a paper.
<b>OUTCOMES RELATED TO SOCIAL COMPETENCES</b>			
EUK1	The doctoral student is ready to critically evaluate the analysis of the results of heat and mass transfer research described in the subject literature.	E_K01, E_K03	Involvement in class activities.
EUK2	The doctoral student recognizes the importance of knowledge in the field of thermal engineering.	E_K01, E_K03	Involvement in class activities.

### Course outline

No.	Contents	Learning outcomes for the course	No. of hours
<b>LECTURE</b>			
W1	Types of heat transfer and the basic laws describing them: conduction, convection, radiation.	EUW1, EUK2,	1
W2	Types of mass transfer and basic laws describing them: diffusion, convection, penetration.	EUW2, EUK2	2
W3	Influence of heat transfer conditions on the design of devices: free and forced convection.	EUW1, EUU1, EUK1, EUK2	2
W4	Application of the phase transformation processes in the construction of heat exchangers: boiling, condensation, melting.	EUW1, EUU1, EUK1, EUK2	2
W5	Influence of mass transfer conditions on the design of devices: mass transfer during phase transitions, drying, absorption and rectification processes, evaporative cooling.	EUW2, EUU2, EUK1, EUK2	3
W6	Thermal radiation.	EUW1, EUU1, EUK1, EUK2	1
W7	Transient processes of heat conduction, heat accumulation.	EUW1, EUU1, EUK1, EUK2	2
W8	Methods of calculating heat exchangers.	EUW1, EUU1, EUW2, EUU2, EUK1, EUK2	2

### 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 AN ACADEMIC TEACHER	
Hours allotted in the syllabus	15
Consultations	1
Examination / course credit assignment	2
HOURS WITHOUT THE PARTICIPATION OF AN ACADEMIC TEACHER	
Independent study of the course contents	8
Preparation of a paper, a report, a project, a presentation, a discussion	4
ECTS POINTS STATEMENT	
Total number of hours	30
The ECTS points number	1

#### Preliminary requirements

No.	Requirements
1	Course credit for a completed course in thermodynamics.

#### Course credit assignment conditions / method of the final grade calculation

No.	Description
COURSE CREDIT ASSIGNMENT CONDITIONS	
1	75% attendance in class.
2	Preparation of a written paper on the methodology of calculating a heat or mass exchanger.
METHOD OF THE FINAL GRADE CALCULATION	
Grade for the presentation of a paper, taking into account the attendance.	

#### Additional information

None specified.
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#### The course reading list

1	Wiśniewski St., Wiśniewski T.S., <i>Wymiana ciepła</i> , Warszawa, 2000, WNT.
2	Zarzycki R., <i>Wymiana ciepła i ruch masy w inżynierii środowiska</i> , Warszawa, 2005, WNT.
3	Niezgoda-Żelasko B., Zalewski W., <i>Chłodnicze i klimatyzacyjne wymienniki ciepła. Obliczenia cieplne</i> , Kraków, 2012, Wydawnictwo Politechniki Krakowskiej.
4	Kostowski E., <i>Przepływ ciepła</i> , Gliwice, 2000, Wydawnictwo Politechniki Śląskiej.
5	Hobler T., <i>Ruch ciepła i wymienniki</i> , Warszawa 1979, WNT.
6	Yunus A. Cengel, <i>Heat and Mass Transfer</i> , London, 2007, McGraw-Hill.