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	Modelowanie zjawisk przepływowo-cieplnych
Name of the course in English	Modelling of flow and thermal phenomena
Number of the ECTS points	1
Language of instruction	Polish
Category of the course	Elective
Field of education	Engineering and Technology
Discipline of education	Environmental engineering, ,mining and power engineering
Person responsible for the course Contact	Prof. Słowomir Grądziel, *doctor hab.*, MSc in Eng. , professor of CUT slawomir.gradziel@pk.edu.pl

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

Semester	Credit type (G / NG)*	Lecture	Practical class	Laboratory	Computer Laboratory	Project class	Seminar
2, 3, 4, 5, 6	G	15	0	0	0	0	0

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

Course objectives

Code	Objective description
Objective 1	Acquiring the modeling skills for furnace chambers of power boilers
Objective 2	Acquiring the ability to model flow phenomena occurring in the heating surfaces of power boilers

Learning Outcomes

Code	Description of the learning outcome adjusted to the specific characteristics of the discipline	Learning outcome symbol in the CUT SD	Methods of verification
OUTCOMES RELATED TO KNOWLEDGE			
EUW1	The doctoral student knows the methods of modeling furnace chambers	E_W01 E_W02	Involvement in class activities, presentations
EUW2	The doctoral student knows the laws describing the flow-thermal phenomena that occur in the heating surfaces of boilers	E_W01 E_W02	Involvement in class activities, presentation
OUTCOMES RELATED TO SKILLS			
EUU1	The doctoral student is able to compose the heat balance of the boiler furnace chamber	E_U01	Graded presentation

EUU2	The doctoral student is able to apply the laws describing flow phenomena in practice	E_U01	Presentation, discussion
OUTCOMES RELATED TO SOCIAL COMPETENCES			
EUK1	The doctoral student is prepared to recognize the importance of knowledge of modeling energy installations	E_K03 E_K01	Discussion

Course outline

No.	Contents	Learning outcomes for the course	No. of hours
LECTURE			
W1	The operation principle and construction of a steam boiler. Classifikation of energy boilers. Typical constructions of power boilers. Flow-through boilers. Boilers for supercritical parameters. Fluidized boilers.	EUW1, EUW2	3
W2	Heat balance of the furnace chamber. Methods of calculating the furnace chamber: CKTI and zone method.	EUW1, EUW2, EUU2, EUK1	3
W3	Boiler evaporator: drum, downpipes, screens. The structure of the flow of the steam-water mixture in the vertical pipe channel. Overheaters. Methods of controlling the temperature of superheated steam. Water heaters. Air heaters.	EUW1, EUW2, EUU2, EUK1	3
W4	Laws describing flow: mass, momentum and energy equations. Practical use of equations	EUW1, EUW2, EUU2	3
W5	Models used to calculate the heat transfer coefficient and pressure loss in smooth and internally finned tubes	EUW1, EUW2, EUU2, EUK1	3

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 THE ACADEMIC TEACHER	
Hours allotted in the syllabus	15
Consultations	1
Examination / course credit assignment	1
HOURS WITHOUT THE PARTICIPATION OF THE ACADEMIC TEACHER	
Independent study of the course contents	8
Preparation of a paper, report, project, presentation, discussion	5
ECTS POINTS STATEMENT	
Total number of hours	30
The ECTS points number	1

Preliminary requirements

No.	Requirements

1	Basic knowledge of heat transfer

Course credit assignment conditions / method of the final grade calculation

No.	Description
COURSE CREDIT ASSIGNMENT CONDITIONS	
1	75% attendance in class.
2	Delivery of an oral presentation on a selected topic.
	METHOD OF THE FINAL GRADE CALCULATION
	Credit assigned on the grounds of the delivery of the presentation and attendance in class.

Additional information

None

The course reading list

1	Taler J., Thermal and flow processes in large power boilers. Modeling and monitoring, Warsaw, 2011, PWN
2	Orłowski P., Dobrzanski W., Szwarc E., Steam boilers, structure, calculations., Warsaw, 1979, WNT
3	Pronobis M., Modernization of power boilers, Warsaw, 2002, WNT
4	Zima W., Grądziel S., Simulation of transient processes in heating surfaces of power boilers, LAMBERT Academic Publishing, 2013
5	Grądziel S., Modeling of flow-thermal phenomena occurring in an evaporator of a power boiler with natural circulation, Monograph 406, Mechanics series, Krakow, 2012, CUT