COURSE DESCRIPTION CARD - SYLLABUS

Course name
Applied thermodynamics [N1Energ2>TT2]

Course

Field of study
Power Engineering

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
10

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

dr hab. inż. Magda Joachimiak prof. PP
magda.joachimiak@put.poznan.pl

dr inż. Radosław Jankowski
radoslaw.jankowski@put.poznan.pl

Lecturers

Prerequisites

The student entering the subject should have a basic knowledge of mathematics, physics and fluid mechanics, as well as a first course in thermodynamics. The student should be able to retrieve information (from libraries and the internet) and should have a willingness to work together as part of a team.

Course objective

The aim of the course is to deepen and consolidate the knowledge of technical thermodynamics acquired in the previous semester, to prepare the student to solve already more complex thermodynamic-fluid examples. To familiarise the student with basic measurement methods in the area of technical thermodynamics.

Course-related learning outcomes

Knowledge:
The student shall have advanced, established and in-depth knowledge of thermodynamics necessary to

describe and analyse the operation of energy components and systems and the physical and chemical processes involved in the generation, storage and supply of energy.
The student has a theoretically underpinned knowledge covering thermodynamics, including the knowledge necessary to understand complex methods and technologies of energy generation, storage and supply, including in networks dominated by unstable sources.
The student knows and understands to an advanced degree the phenomena associated with the processes of combustion and gasification of fuels, the chemical analysis of processes occurring in the power industry, and the influence of the parameters of energy carriers and operating factors on the efficiency of the process of energy production, storage and supply.

Skills:
The student is able to obtain information from literature, databases and other sources, as well as to integrate the information obtained, interpret, evaluate, critically analyse and synthesise it in order to draw appropriate conclusions and to formulate and issue opinions specifying the conditions and technologies of assembly of both typical and atypical equipment and power installations.
The student is able to work individually and in a team to develop measures to reduce the risk of emergencies related to the energy supply process, he is able to develop emergency plans related to the possibility of occurrence of hazards to people, property and the environment, he is able to develop and implement a schedule of works ensuring compliance with the deadlines.

Social competences:
Students are aware of a critical assessment of their knowledge, recognise its significance in solving cognitive and practical problems, as well as in taking decisions in processes related to energy generation, storage and supply, both under normal working conditions and under changing circumstances and time pressure.
The student is aware of the necessity to initiate changes both in the working environment and for the public interest, related to the implementation of new technologies and technical and organisational solutions in the power industry.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
The knowledge acquired in the lecture is verified by an 80-minute final assessment. The colloquium consists of 5 open questions scored from 0 to 2 and 2 assignments scored from 0 to 5. Pass threshold: > 50% of the points.
Laboratory classes:
Continuous assessment in each class of skills and competences by solving engineering tasks and special case analyses. Assessment of the student's knowledge and skills on the basis of partial marks from laboratory exercises and marks of completed reports.

Programme content

The classes on the isobaric evaporation process of water and the transformations of water and steam in p-v, T-s, and h-s diagrams focus on the analysis of thermodynamic processes, such as evaporation, and present enthalpy and entropy charts for water and steam. They also cover fuel characterization and the analysis of combustion processes for various fuels, including gaseous, liquid, and solid fuels, with particular emphasis on the stoichiometry of oxidation, oxygen demand, and the emission of exhaust gases and harmful compounds.

Course topics

Lecture:
Isobaric evaporation of water. Water and vapour transformations in p-v, T-s and h-s systems. Analysis of enthalpy-entropy diagrams for water and steam. Steam as a thermodynamic agent in energy terms. Characterisation of fuels. Analysis of combustion of gaseous, liquid and solid fuels. Stoichiometric equations of fuel oxidation. Oxygen and air requirements under stoichiometric and real conditions. Air bearing factor and equivalence factor. Flue gas composition and formation and emission of harmful compounds.
Laboratory classes:

Measurement of basic thermodynamic parameters (pressure, temperature, humidity), measurements in the area of heat transfer and thermal conductivity, measurement of technical parameters of basic energy devices, determination of the properties of the thermodynamic medium water steam, determination of fuel properties.

Teaching methods

Lecture: Multimedia presentation illustrated with examples given on the board.
Laboratory classes: Multimedia presentation, examples presented on the board, students performing practical tasks indicated by the instructor.

Bibliography

Basic:
1. Wiśniewski S., Wiśniewski T.; Termodynamika techniczna, PWN, Warszawa 2017
2. Szargut J.; Termodynamika; PWN; Warszawa 2000
3. Pudlik W.; Termodynamika; Wydawnictwo Politechniki Gdańskiej; Gdańsk 2020
4. Walczak J.; Termodynamika techniczna; Wydawnictwo PWSZ; Konin 2009
5. Szargut J., Guzik A., Górniak H.; Zadania z termodynamiki technicznej; Wyd. Politechniki Ślaskiej; Gliwice 2011
6. Walczak J., Grzelczak M.; Termodynamika techniczna: Zbiór zadań; Wydawnictwo PP; Poznań 2013

Additional:
1. Sadłowska-Sałęga A.; Materiały pomocnicze do ćwiczeń z przedmiotu: Termodynamika techniczna;
2. Cengel Y., Boles M.A.; Thermodynamics, an engineering approach; Mc Graw Hill; 2008
3. Incropera, F., DeWitt, D., Fundamentals of heat and mass transfer; Wiley; 2008
4. Ghiaasiaan M.; Convective heat and mass transfer; Cambridge University Press; 2014
5. Ciupek B., Gołoś K., Jankowski R., Nadolny Z.; Effect of Hard Coal Combustion in Water Steam Environment on Chemical Composition of Exhaust Gases; Energies; 2021, vol. 14, no. 20, s. 6530-1-6530-24

Breakdown of average student's workload

	Hours	ECTS
Total workload	80	3,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	50	2,00