COURSE DESCRIPTION CARD - SYLLABUS

Course name
Thermal management in industry [N1Energ2>GCwP]

Course

Field of study
Power Engineering

Year/Semester
5/9

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
20

Laboratory classes
10

Other
0

Tutorials
0

Projects/seminars
10

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The student should have a basic knowledge of thermodynamics, fluid mechanics and heat transfer. Knowledge of the construction of fossil fuel-fired power machines. In addition, he/she should be able to prepare and give a short presentation of the results of an engineering task communicating using specialised terminology in the field of thermal power engineering.

Course objective

To familiarise the student with systems operating in the thermal power industry and to achieve the ability to develop the assumptions necessary for the design or modernisation of systems in the thermal power industry area. This includes equipment such as boilers, turbines, compressors, heat exchangers. Practical familiarisation with the construction of heat engines and individual systems in the energy systems.

Course-related learning outcomes

Knowledge:
Students will gain an advanced knowledge and understanding of phenomena associated with fuel combustion and gasification processes, the chemical analysis of processes taking place in the thermal power industry, and the influence of parameters of energy carriers and operating factors on the

efficiency of energy production, storage and supply processes.
Students will gain well-ordered and theoretically grounded knowledge of telecommunications, analogue and digital data transmission in wired and wireless channels, basic issues of local and wide area computer networks and the areas of their application in the field of thermal power engineering, management of power network operation, thermal power facilities, and the principles of energy transmission in networks and microgrids.
Students will have a structured and theoretically based knowledge of the basic technologies of thermal energy conversion and solutions used for its recovery in industrial processes, they will know and understand their impact on the environment.

Skills:
The student is able to carry out the assembly, commissioning and disassembly of equipment, installations and thermal networks, using appropriately selected methods, equipment and information technology, diagnose the causes of malfunctions, failures or operational disruptions, and also plan and carry out works related to their inspection, overhaul, repair and modernisation under various conditions.
Students will be able, in formulating and solving tasks in the field of energy security of various energy elements, systems and systems, including residential buildings, public buildings and production processes, to use analytical, simulation and experimental methods to estimate energy demand and energy security on a national scale, noting environmental, economic and legal aspects of the solutions applied.

Social competences:
The student is aware of the necessity to initiate changes both in the working environment and in the public interest, related to the implementation of new technologies and technical and organisational solutions in industrial energy management.

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 in a final exam lasting 80 minutes, consisting of 18 open questions scored from 0 to 1. Pass threshold: > 50% of the points.
Project: The skills acquired in the design class will be assessed on the basis of the solution of an engineering problem presented by the student during a presentation in the last class.
Laboratory exercises: Continuous assessment in each class of skills and competences through the solution of engineering tasks and special case analyses, assessment of student's knowledge and skills based on the partial marks of the exercises and the marks of the completed reports.

Programme content

Assessment of the energy efficiency of devices and energy systems, including energy efficiency technologies, optimization of energy consumption, and reduction of energy losses, as well as analysis of investment costs in energy efficiency. Heat exchangers in steam cycles, steam turbines, non-contact seals, combined steam-gas cycles, and the safety of cogeneration and trigeneration processes, along with legal regulations regarding the operation of thermal infrastructure and the diagnostics of the condition of energy devices.

Course topics

Lecture:
Generation of thermal energy in a distributed energy system: characteristics of distributed energy generation systems with particular reference to thermal energy, principle of operation, modes of control and interchangeability of fuels in distributed systems.
Legal regulations for distributed energy generation systems.
Characteristics of combined heat, power and cooling systems, operating principle and fuels used.
Energy efficiency assessment of energy equipment and systems. Energy efficiency technologies, optimisation of energy consumption, reduction of energy losses in systems and appliances, cost analysis of investments in energy efficiency.
Exchangers in the steam cycle, energy condensers, characteristics of heat transfer phenomena in condensation.

Diagnosis of steam turbines - assessment of wear condition.
Types, performance characteristics of non-contact seals used in power machines.
Methods of increasing the efficiency of thermal circuits.
Steam and gas circuits.
Safety of cogeneration and trigeneration processes in industrial systems.
Technologies for monitoring and diagnosing the condition of thermal energy facilities.
Legal regulations on the safety and reliability of operation of equipment and systems constituting thermal energy infrastructure systems, including legal and technical requirements (UDT/CLDT).
Characteristics of procedures and activities carried out in thermal energy infrastructure systems to perform diagnostics.
Threats and risks in thermal energy generation processes caused by emergency situations.
Project:
Solution of an engineering task in the field of industrial thermal management.
Labs:
Investigations of the energy efficiency of gaseous and solid fuel-fired power equipment and machinery, and regenerative heat exchangers.

Teaching methods

Lecture: Multimedia presentation, illustrated by examples given on the blackboard.
Laboratory exercises: Multimedia presentation, examples given on the blackboard, students' performance of practical tasks indicated by the instructor.
Project: Multimedia presentation illustrated by examples given on the blackboard and performance of tasks given by the instructor - practical exercises.

Bibliography

Basic:
T. Chmielniak; Technologie energetyczne; Wyd. Pol. Śląskiej; 2004
J. Szargut, A. Ziębik; Podstawy energetyki cieplnej; PWN; Warszawa 1998
R. Domański; Magazynowanie energii cieplnej; PWN; Warszawa, 1990
R. Janiczek; Eksploatacja elektrowni parowych; WNT; Warszawa 1980
J. Paska; Rozproszone źródła energii; OWPW; Warszawa 2010
Kucharska A. Transformacja energetyczna, PWN 2021
J. Paska; Wytwarzanie rozproszone energii elektrycznej i ciepła; OWPW; Warszawa 2010
K. Buczek; Kogeneracja ciepła i energii elektrycznej w małych elektrociepłowniach; KeBe; Krosno 2018
J. Skorek; Gazowe układy kogeneracyjne, WNT, Warszawa 2005
J. Górski; Energetyka cieplna: obsługa i eksploatacja urządzeń, instalacji i sieci; Tarbonus; Kraków 2008

Additional:
R. Bartnik; Elektrownie i elektrociepłownie gazowo-parowe; WNT; Warszawa 2009
Z. Gnutek, W. Kordylewski; Maszynoznawstwo energetyczne; OWPW; Wrocław 1994
A. Szkarowski, L. Łatowski; Ciepłownictwo; WNT; Warszawa 2006
B. Gniewek-Grzybczyk; Energetyka gazowa: obsługa i eksploatacja urządzeń, instalacji i sieci; Tarbonus; Kraków 2008
T. R. Fodemowski; Pomiary cieplne (cześć I i II); WNT; Warszawa 2001
S. Kruczek; Kotły. Konstrukcja i obliczenia; Wydawnictwo Politechniki Wrocławskiej; Wrocław 2001
S. Perycz; Turbiny parowe i gazowe; Wyd. Pol. Gdańskiej; 1982
T. Chmielniak; Turbiny cieplne; Wyd. Pol. Śląskiej; 2004
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L. Mustafa, R. Ślefarski, R. Jankowski; Thermodynamic Analysis of Gas Turbine Systems Fueled by a CH4/H2 Mixture; Sustainability; 2024; vol. 16, iss. 2, s. 1-15
M. Joachimiak, D. Joachimia, P. Krzyślak; Analysis of heat flow in a tube bank of a condenser considering the influence of air; Archives of Thermodynamics; 2017; vol. 32, no. 3, s. 119-134
D. Joachimiak; Novel Method of the Seal Aerodynamic Design to Reduce Leakage by Matching the Seal Geometry to Flow Conditions; Energies; 2021; vol. 14, no. 23, s. 7880-1-7880-16
Czyzewski P, Goraj R. Slefarski R. The impact of hydrogen addition into natural gas on combustion characteristic and operational parameters of public natural gas distribution network, JMTE, 1, 71, 2019
D. Joachimiak, red. A. Liberek, Uszczelnienia bezdotykowe - badania, modelowanie i optymalizacja; Wydawnictwo Politechniki Poznańskiej; 2021; 172 s.

D. Joachimiak, A. Frąckowiak; Experimental and numerical analysis of the gas flow in the axisymmetric radial clearance; Energies; 2020; vol. 13, no. 21, s. 5794-1-5794-13

Breakdown of average student's workload

	Hours	ECTS
Total workload	142	5,00
Classes requiring direct contact with the teacher	42	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	100	3,50