POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Applied Thermodynamics [S2MiBP1E>TT]

Course

Field of study
Mechanical and Automotive Engineering

Year/Semester
1/1

Area of study (specialization)
Product Engineering

Profile of study
general academic

Level of study
second-cycle

Course offered in
english

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

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Prerequisites

Student should have basic knowledge in mathematics (integration, differentiation) and in physics, also in thermodynamics (first course). Should be able to obtain information from the library and internet, should be ready to cooperate in a team.

Course objective

The purpose of the course is to deepen the student knowledge on thermodynamics and to prepare him to solve more complex problems. The purpose of the subject is also to draw attention to the issue of ecology.

Course-related learning outcomes

Knowledge
Has a basic knowledge of the mechanics of solids and discrete systems with many degrees of freedom, mathematical modeling of physical and mechanical systems based on d'Alembert's principle and Lagrange's equations, mathematical description of materials using constitutive equations.

2
Has extended knowledge of thermodynamics and fluid mechanics to the extent necessary to understand the principle of operation and calculations of thermodynamic and flow processes occurring in working machines such as heating, cooling, drying, thermal and pressure agglomeration, etc., pneumatic transport, energy conversion, etc.
Has a general knowledge of the types of research and methods of testing working machines with the use of modern measurement techniques and data acquisition.
Skills
He can estimate the potential threats to the environment and people from the designed working machine and vehicle from a selected group.
Is able to carry out basic measurements of mechanical quantities on the tested working machine with the use of modern measuring systems.
Is able to use the acquired knowledge in the field of thermodynamics and fluid mechanics to simulate thermodynamic processes in technological systems of machines, using specialized computer programs.
Social competences
It is ready to fulfill social obligations, inspire and organize activities for the benefit of the social environment.
It is ready to initiate actions for the public interest.
Is willing to think and act in an entrepreneurial manner.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: knowledge acquired during the lecture is verified by a 90-minute colloquium.
In tutorial class the knowledge is verified by a final test.

Programme content

Lecture: Definition of work, internal energy and enthalpy (ideal and real gas). The first law of thermodynamics (the closed and opened systems). Specific heat. Free energy and free enthalpy. Mixture of perfect gases. Spontaneous processes, irreversibility of processes, dissipation heat. The second law of thermodynamics. Analysis of basic thermodynamic processes: isothermal process, adiabatic process, isochoric process, isobaric process and reversible process, polytropic process. Efficiency of compression and expansion processes. Thermal efficiency of the gas power cycles - methods for optimizing the cycles. Supercritical fluids. Water vapor, property diagrams for phase changes processes. Vapor cycles and their thermal efficiency. The vapor-gas cycles. Theoretical and actual combustion processes. Flue gas composition. Heat of combustion. The basic processes of humid air and drying process. The thermodynamic phenomena in pneumatic systems. Heat transfer. Conduction through membranes without and with an internal heat source, natural and forced convection, radiation (basic concepts of radiation, Stefan Boltzmann's law, radiation heat exchangers).
3
Tutorial classes: solving practical problems (the first and second law of thermodynamics, power cycles, efficiency). Calculations of the air demand in combustion processes, exhaust composition. Calculations of adiabatic dryers

Teaching methods

Lecture: multimedia presentation illustrated with examples on the board.
In the classroom (tutorial), the practical problems are solved on the board.

Bibliography

Basic
1. Szargut, J. Termodynamika, PWN, Warszawa, 2000.
2. Demichowicz-Pigoniowa, J., Obliczenia fizykochemiczne, PWN, Warszawa, 1984.
3. Wiśniewski, S., Wiśniewski, T., Wymiana ciepła, WNT, 2002.
4. Szargut, J., Guzik, A., Górniak, H., Zadania z termodynamiki Technicznej, Wyd. Politechniki Ślaskiej, Gliwice, 2011.
5. Furmański, P., Domański, R., Wymiana ciepła, Przykłady obliczeń i zadania, Oficyna Wydawnicza Politechniki Warszawskiej, 2002.
Additional

1.Cengel, Y., Boles, M.A., Thermodynamics, an engineering approach, Mc Graw Hill, 2008.
2. Incropera, F., DeWitt, D., Fundamentals of heat and mass transfer, Wiley, 2008 3. Ghiaasiaan, M., Convective heat and mass transfer, Cambridge University Press, 2014
3. Ghiaasiaan, M., Convective heat and mass transfer, Cambridge University Press, 2014

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
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)	20	1,00