GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | Thermodynamics, PG_00055881 | | |
| Field of study | Power Engineering, Power Engineering, Power Engineering | | |
| Date of commencement of studies | October 2023 | Academic year of realisation of subject | 2024/2025 |
| Education level | first-cycle studies | Subject group | Obligatory subject group in the field of study<br>Subject group related to scientific research in the field of study |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 2 | Language of instruction | Polish |
| Semester of study | 3 | ECTS credits | 9.0 |
| Learning profile | general academic profile | Assessment form | exam |
| Conducting unit | Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Jan Wajs | |
| | Teachers | dr inż. Marcin Jewartowski<br>dr inż. Stanisław Głuch<br>dr inż. Waldemar Targański<br>dr inż. Michał Pysz<br>Michał Rogowski<br>dr inż. Denys Stepanenko<br>Jakub Łukasik<br>dr hab. inż. Jan Wajs<br>dr inż. Tomasz Minkiewicz | |

| Lesson types and methods of instruction | Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|---|
| | Number of study hours | 45.0 | 30.0 | 30.0 | 0.0 | 0.0 | 105 |
| | E-learning hours included: 0.0 | | | | | | |

| Learning activity and number of study hours | Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|---|
| | Number of study hours | 105 | 9.0 | 111.0 | 225 |

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| Subject objectives | Student acquire basic knowledge of thermodynamics in the dimension of theory and practice. |

## Learning outcomes

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_W15] knows and understands the basic quantities characteristic methods for thermodynamics, fluid mechanics and hydraulics, hydrology; knows the calculation methods and IT tools necessary to analyse the results of laboratory and field work | Student uses graphs and tables of the physical properties to prepare laboratory reports. The student knows the methods of measuring thermal parameters. Student is able to interpret the results of measurements or calculations of energy balance for various machines. | [SW1] Assessment of factual knowledge |
| [K6_U06] is able to use the basic knowledge on the operation of energy equipment in the field of thermal power plants, thermal and energy and heating systems, combustion engines, compressors and rotating machines to assess the technical condition of the system | Student possesses the knowledge needed to identify physical phenomena occurring during the operation of simple thermodynamic systems (open and closed). On this basis, he correctly describes the types of energy conversion or transformation occurring in them. | [SU2] Assessment of ability to analyse information |
| [K6_W02] has a basic knowledge of physics (including optics, electricity and magnetism), chemistry, technical thermodynamics, fluid mechanics and general mechanics needed to understand and describe the basic phenomena occurring in devices and systems, energy plants and transmission networks and their environment | Student defines basic concepts of thermodynamic, 1st and 2nd Law of Thermodynamic and state equations of gases. Student describes gas/steam cycles. Student uses the theory of moist gases and explains fundamentals of thermodynamic combustion. | [SW1] Assessment of factual knowledge |
| [K6_U05] is able to formulate and carry out energy balances in devices and energy systems, also perform an energy audit of a simple building object, is able to perform a preliminary profitability analysis of a planned energy investment | Student is able to write the energy balance of the device (e.g. piston engine, compressor heat pump, refrigerating unit). | [SU1] Assessment of task fulfilment<br>[SU4] Assessment of ability to use methods and tools |

## Subject contents

LECTURE: Basic concepts. The first law of thermodynamics. Ideal gas model. Properties of ideal, semi-ideal and real gases. Gas laws, thermal and caloric equation of state. Characteristic processes of ideal gas. Gas mixtures. Thermodynamic gas cycles. Entropy. The second law of thermodynamics and its consequences. Isobaric evaporation process. Properties of mono-component saturated steam. Properties of superheated steam. Characteristic processes of steam. Thermodynamic steam cycles. Gas mixtures and moist gases. Mollier diagram and the basic moist air processes. Fundamentals of refrigeration. Basics of compressor and sorption heat pumps. Elements of combustion thermodynamics.

EXERCISES: Simple conversion of energy, heat, work. The balances of power of open or closed thermodynamics systems. State and functions of state of ideal and semi-ideal gases and gas mixtures. Characteristic processes of gases. Gas thermodynamic cycles. Characteristic changes of steam. Calculations thermodynamic steam cycles.

LABORATORIES: Measurements of thermodynamic parameters: temperature and pressure. Determination of mass flow rate. Determination of air and water enthalpy. Energy balance of heat pump. Testing of the refrigerating unit. Determination of calorific value of solid and gas fuels. Energy balance of piston engine. Testing of the compressor.

## Prerequisites and co-requisites

Knowledge from course of physics and mathematics.

## Assessment methods and criteria

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Written exam | 56.0% | 50.0% |
| Middterm colloquiums | 56.0% | 30.0% |
| Laboratory reports | 100.0% | 20.0% |

## Recommended reading

Basic literature


- Y. Cengel, M. Boles, Thermodynamics An Engineering Approach, 8th Edition, Wiley, 2014.
- M.J. Moran, H.N. Shapiro, D.D. Boettner, M.B. Bailey, Fundamentals of Engineering Thermodynamics 8th Ed., Wiley, 2014.
- R. Mayhew, Engineering thermodynamics/Work & Heat Transfer. Wiley & Sons Inc. 1993, USA.

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| | Supplementary literature | no requirements |
| | eResources addresses | Adresy na platformie eNauczanie: |
| Example issues/ example questions/ tasks being completed | Present equations of first law of thermodynamics. Describe Carnot Cycle. Describe Rankine / Otto / Diesel / Brayton cycle. Methods of improving the efficiency of Clausius-Rankine cycle. Present definitions of second law of thermodynamics. Operational principle of compressor heat pumps. Heating and humidification of air. Energy balance of piston engine. | |
| Work placement | Not applicable | |

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