# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Thermodynamics [S2ZE1E>Term]

## Course

Field of study
Green Energy

Year/Semester
1/1

Area of study (specialization)
–

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
15

Other (e.g. online)
0

Tutorials
30

Projects/seminars
0

## Number of credit points

4,00

## Coordinators

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## Lecturers

## Prerequisites

The student starting this course should have basic knowledge of the basics of thermodynamics and the processes of energy flow and conversion in thermal-flow machines and devices. They should also have the ability to effectively self-educate in a field related to the chosen field of study and be ready to cooperate as part of a team.

## Course objective

Acquainting with basic thermodynamic processes, thermodynamic transformations and equations of energy conservation. Understanding the methods of describing various thermodynamic factors and thermodynamic cycles that implement the assumed processes of thermal and mechanical energy conversion in order to modernize or reconstruct technological systems in the field of thermal energy. Practical mastery of the ability to describe the implementation of thermal processes.

## Course-related learning outcomes

Knowledge:
Has knowledge in the field of physics, including the basics of classical mechanics, optics, electricity and magnetism, solid state physics, quantum and nuclear physics, necessary to understand specialist

lectures in the field of the theory of construction materials and materials science, theory of machines and mechanisms, theory of electric drives and mechatronic systems. Has basic knowledge of technical thermodynamics, ie the theory of thermodynamic changes, heat flow, thermal machines and heating, drying and cooling devices. Has a basic knowledge of the methods of linear measurements, measurements of stresses, strains, velocities, temperatures and fluid streams, including measurements of these quantities by electrical means.

Skills:
Can properly use modern equipment for measuring major physical quantities, used in machine research and production control. Can perform elementary technical calculations in the field of fluid mechanics and thermodynamics, such as heat and mass balances, pressure losses in pipelines, select parameters of blowers and fans for ventilation and transport systems, and calculate thermodynamic courses in thermal machines. Can create a system diagram, select elements and perform basic calculations using ready-made computational packages of mechanical, hydrostatic, electric or hybrid machine drive system.

Social competences:
Is ready to recognize the importance of knowledge in solving cognitive and practical problems and to consult experts in case of difficulties in solving the problem on his own. Is ready to fulfill social obligations and co-organize activities for the benefit of the social environment. 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:
- assessment of the knowledge and skills shown on the written test - 1.5 hour exam
Exercises:
- the knowledge acquired during the exercises is verified by two 45-minute tests carried out during classes 3 and 7
Laboratories:
- checking the preparation (knowledge) for laboratory classes, - rewarding practical knowledge gained during previous laboratory exercises, - assessment of knowledge and skills related to the performance of measurements and their preparation in the form of a report.

## Programme content

Lecture:
Introduction - basic dependencies, thermodynamic factor model. First law of thermodynamics. Perfect gases. Basic dependencies for open systems. Second law of thermodynamics. Efficiency of cycles and changes. Typical transformations of an ideal gas. Real gases. Basics of description of combustion processes. Engine circuits. Left-hand circuits. Steam power stations. Basics of heat flow.
Exercises:
The issues presented in the lecture are solved in the form of tasks.
Laboratories:
1. Temperature measurement and calibration.
2. Thermometry. Temperature measurements using resistance and thermoelectric thermometers.
3. Pressure measurement and calibration.
4. Energy balance. First law of thermodynamics.
5. Measurement of the heat flux.
6. Perfect gas. The process of expansion in ideal gases.
7. Investigation of the TA60 absorption aggregate.

## Course topics

none

## Teaching methods

1. Lecture: multimedia presentation, illustrated with examples given on the board.
2. Exercises: examples given on the blackboard and carrying out the tasks given by the teacher - practical exercises.

3. Laboratories: Practical classes in laboratory and didactic positions.

## Bibliography

Basic:
1. M.J. Morano, H.N.Shapiro: Fundamentals of Engineering Thermodynamics, John Wiley & Sons, New York, 1998
2. C. William Reynolds, P. Colonna: Thermodynamics Fundamentals and Engineering Applications, ‍ Cambridge University Press, 2018
3. A. Ben-Naim: Modern Thermodynamics, WSPC, 2016
4. Y. Cengel, R. Turner, J. Cimbala: Fundamentals of Thermal-Fluid Sciences, McGraw Hill, 2016
5. A. Shavit, C. Gutfinger: Thermodynamics: From Concepts to Applications, Second Edition, CRC Press, 2008

Additional:
1. P. Jacobs, Thermodynamics, IMPERIAL COLLEGE PRESS, 2013
2. M.J. Morano, H.N.Shapiro: Fundamentals of Engineering Thermodynamics, John Wiley & Sons, New York, 1998

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 100 | 4,00 |
| Classes requiring direct contact with the teacher | 60 | 2,50 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 40 | 1,50 |