# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Elements of thermodynamics and fluid mechanics [S1Trans1>ETiMP]

## Course

Field of study
Transport

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
15

Laboratory classes
15

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

## Number of credit points

3,00

## Coordinators

prof. dr hab. inż. Andrzej Frąckowiak
andrzej.frackowiak@put.poznan.pl

## Lecturers

## Prerequisites

KNOWLEDGE: has basic knowledge of mathematics and physics SKILLS: can use concepts and methods in the description of physical phenomena, can use the acquired knowledge to analyze specific phenomena and physical processes. SOCIAL COMPETENCES: is able to cooperate in a group, assuming different roles in it, is able to define priorities important in solving the tasks set before him, shows independence in solving problems, acquiring and improving acquired knowledge and skills.

## Course objective

The aim of the course is to provide students with information on thermodynamics and fluid mechanics, definitions and concepts. Students acquire knowledge and skills in solving problems in thermodynamics and fluid mechanics.

## Course-related learning outcomes

Knowledge:
has extended and in-depth knowledge of physics useful for formulating and solving selected technical tasks, in particular for correct modeling of real problems,

Skills:
is able to properly plan and perform experiments, including measurements and computer simulations, interpret the obtained results, and correctly draw conclusions from them

Social competences:
understands that in technology, knowledge and skills very quickly become obsolete

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
The knowledge acquired during the lecture is verified by a 90-minute test carried out during the last lecture. The test consists of 7-10 questions, with different scores. Passing threshold: 50% of points. Final issues, on the basis of which the questions are developed, will be sent to students by e-mail using the university"s e-mail system.
The knowledge acquired during the exercises is verified by two 45-minute tests carried out during the 7th and 15th hours of exercises. Each test consists of 3-7 tasks, with different scores. Passing threshold: 50% of points.
The skills acquired during the laboratory classes are verified on the basis of reports on the implementation of exercises and oral answers before the start of the classes.

## Programme content

Closed and open thermodynamic systems. Basic thermodynamic concepts. Gas thermometer. Thermal equation of state. Reversible and irreversible changes. The first law of thermodynamics for a closed system. State functions. Internal energy, enthalpy. The Gay-Lussac Experience? Joule? Specific heat. The second principle of thermodynamics. Entropy. T-s charts. Application of the second law of thermodynamics to the thermodynamic cycle. Carnot cycle. Thermodynamic transformations. Thermodynamic cycles. Heat conduction, forced and free convection, heat radiation. Fourier"s law, Newton"s formula and Stefan"s and Boltzmann"s law, One-dimensional fixed conduction and heat transfer: plane and cylindrical partition. Euler"s equation of equilibrium. Pascal"s law. Manometric formula. The hydrostatic paradox. Pressure units. Archimedes" law. Swimming stability. Bernoulli"s equation. Instruments for velocity and volume flow measurement: Pitot tube, Prantle probe, Ventouri tube. Bernoulli equation for flow with losses. Constitutive compounds for Newton"s fluid. Navier Stokes equation. Examples of one-dimensional solutions to the Navier-Stokes equation.

## Course topics

1. Closed and open thermodynamic systems. Basic thermodynamic concepts. Gas thermometer. Thermal equation of state. Reversible and irreversible changes.
2. The first law of thermodynamics for a closed system. State functions. Internal energy, enthalpy. The Gay-Lussac -Joule's experiment. Specific heat.
3. The second principle of thermodynamics. Entropy. T-s charts.
4. Application of the second law of thermodynamics to the thermodynamic cycle. Carnot cycle.
5. Thermodynamic transformations. Thermodynamic cycles.
6. Euler"s equation of equilibrium. Pascal"s law. Manometric formula. The hydrostatic paradox. Pressure units. Archimedes" law.
7. Bernoulli"s equation. Instruments for velocity and volume flow measurement: Pitot tube, Prantle probe, Ventouri tube. Bernoulli equation for flow with losses.

## Teaching methods

1. Lecture: multimedia presentation, illustrated with examples given on the board.
2. Exercises: performing the tasks given by the teacher.
3. Laboratory: practical exercises.

## Bibliography

Basic
1. Tuliszka E.:Termodynamika Techniczna, PWN, Poznań 1978.
2. Termodynamika Techniczna. Zbiór Zadań, red. Tuliszka E, Poznań, Wydawnictwo Politechniki

Poznańskiej, 1980
3. Ciałkowski M.: Mechanika płynów. Wyd. Politechniki Poznańskiej, 2000.
4. Mechanika Płynów. Zbiór zadań z rozwiązaniami, red. Ciałkowski M., wyd. 1, Po-znań, Wydawnictwo Politechniki Poznańskiej, 2008.
Additional
1. Szargut J.: Termodynamika, PWN, Warszawa 1998.
2. Szargut J.: Termodynamika techniczna, PWN, Warszawa 1991.
3. Szargut J. i in.: Programowy zbiór zadań z termodynamiki technicznej, PWN, War-szawa 1986.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 75 | 3,00 |
| Classes requiring direct contact with the teacher | 45 | 2,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 30 | 1,00 |