COURSE DESCRIPTION CARD - SYLLABUS

Course name
Elements of thermodynamics and fluid mechanics

Course

Field of study
Aerospace engineering

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
First-cycle studies

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

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Knowledge: The student has basic knowledge of mathematics and physics

Skills: The student is able to use the concepts and methods in the description of physical phenomena. The student is able to use the acquired knowledge to analyze specific phenomena and physical processes.

Social competences: The student is able to cooperate in a group, assuming various roles in it. The student is able to determine the priorities important in solving the tasks set before him. The student demonstrates independence in solving problems, acquiring and improving the 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

1. The student has an ordered, theoretically founded general knowledge covering key issues in the field of thermodynamics, gas dynamics and fluid mechanics for flows of high technical speeds, i.e. the theory of thermodynamic transformations, heat flow, thermal and cooling machines [K2A_W15]

Skills

1. The student can use formulas and tables, technical and economic calculations using a spreadsheet, specialized software [K2A_U05]

2. The student can plan and carry out a research experiment using measuring equipment, computer simulations, can take measurements and interpret the results and draw conclusions [K2A_U10]

3. The student can use the language of mathematics (differential and integral calculus) to describe simple engineering problems [K2A_U11]

4. The student can use learned mathematical theories to create and analyze simple mathematical models of machines and their components as well as simple technical systems. Is able to use the programs for calculating mechanical structures by the finite element method integrated with the packages for spatial modeling and correctly interpret their results [K2A_U26]

Social competences

1. The student understands the need for lifelong learning; can inspire and organize the learning process of other people [K2A_K01]

2. The student is ready to critically assess his knowledge and received content, recognize the importance of knowledge in solving cognitive and practical problems and consult experts in the event of difficulties with solving the problem on his own [K2A_K02]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

LECTURE: written credit

TUTORIALS: written credit from the conducted exercises

LABORATORIES: written reports on the conducted laboratory activities

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. Gay-Lussac Joule's experiment. Specific heat. The second law 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.

Teaching methods

Informative (conventional) lecture (providing information in a structured way) - may be of a course (introductory) or monographic (specialist) character.

The exercise method (subject exercises, practice exercises) - in the form of auditorium exercises (applying the acquired knowledge in practice - may take various forms: solving cognitive tasks or training psychomotor skills; transforming a conscious activity into a habit through repetition).

Laboratory (experiment) method (students independently carry out experiments).

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	3,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for tests/exam) [1]	30	1,0

[1] delete or add other activities as appropriate