STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Elements of thermodynamics and fluid mechanics**		Code **1010601231010632051**
Field of study **Transport**	Profile of study (general academic, practical) **(brak)**	Year /Semester **2 / 3**
Elective path/specialty **-**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **1** Classes: **-** Laboratory: **1** Project/seminars: **-**		No. of credits **4**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**2 100%**
Technical sciences	**2 100%**
the sciences	**2 100%**
Physical sciences	**2 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	The student possesses basic knowledge of mathematics and physics.
2	**Skills**	The student has an ability to use the concepts and methods in the description of physical phenomena. The student is able to use acquired knowledge to analyze specific physical processes and phenomena.
3	**Social competencies**	The student is able to cooperate in a team, taking the different roles. The student is able to define priorities in solving the tasks posed before him. The student demonstrates self-reliance in solving tasks, acquiring and improving their knowledge and skills.

Assumptions and objectives of the course:

The aim of this course is to provide students with information concerning fluids thermodynamics and mechanics, definitions and concepts. Students gain knowledge and skills in solving problems concerning thermodynamics and mechanics of fluids.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Has a knowledge of physics, including Thermodynamics - [K1A_W02]
2. Has a structured, theoretically founded knowledge of the mechanics of fluids - [K1A_W04]

Skills:

1. Is able to obtain information from the literature, internet, databases and other sources in Polish and English. Can integrate the information to interpret and learn from them, create and justify opinions. - [K1A_U01]
2. Has the ability to self-educate using modern teaching tools such as remote lectures, webpages and databases, educational software, electronic editions. - [K1A_U06]

Social competencies:

1. Understands the need and knows the possibilities of lifelong learning, knows the need for acquiring new knowledge for professional development. - [K1A_K01]
2. Is able to think and act in an entrepreneurial manner, make decisions, work for the development of the employer and the society. - [K1A_K07]
3. Is aware of the transfer of knowledge to society, takes steps to ensure that the information is understandable. - [K1A_K08]

Assessment methods of study outcomes

Written test of lectures, written and practical credit of laboratory.

Course description

Closed and opened thermodynamic systems. Basic concepts of thermodynamics. Gas thermometer. Thermal state equation. Reversible and irreversible transformations. First law of thermodynamics for closed systems. State functions. Internal energy, enthalpy. Gay-Lussac's experiment. Specific heat. Second law of thermodynamics. Entropy. T-s diagrams. 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 equation and Stefan-Boltzmann's law.

One-dimensional fixed heat conduction and transfer: flat and cylindrical bulkhead. Euler's equilibrium equation. Pascal's law. Manometric equation. Hydrostatic paradox. Pressure units. Archimedes' law. Stability of swimming. Bernoulli's equation. Instruments for measuring the velocity and flow rate: Pitot tube, Prandtl probe, Venturi tube. Bernoulli's equation for lossy flow. Constitutive relations for the Newtonian fluid. Navier-Stokes' equation. Examples of one-dimensional solutions to the Navier-Stokes' equation.

Basic bibliography:

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, Poznań, Wydawnictwo Politechniki Poznańskiej, 2008

Additional bibliography:

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, Warszawa 1986

Result of average student's workload

Activity	Time (working hours)
1. Preparation for the lectures	5
2. Participation in the lecture	15
3. Consolidation of the lecture content	10
4. Consultation	5
5. Preparation for the pass	20
6. Participation in the pass	1
7. Preparation for the laboratory classes	15
8. Participation in the laboratory classes	15
9. Consultation	10
10. Preparation for the pass	10
11. Participation in the pass	1

Student's workload

Source of workload	hours	ECTS
Total workload	107	4
Contact hours	47	2
Practical activities	30	1