COURSE DESCRIPTION CARD - SYLLABUS

Course name

Fluid thermomechanics and environmental protection

Course

Field of study

Aerospace Engineering

Year/Semester

3/6

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

elective

Number of hours

Lecture

45

Laboratory classes

45

Other (e.g. online)

0

Tutorials

15

Projects/seminars

0

Number of credit points

7

Lecturers

Responsible for the course/lecturer:

Prof. dr hab. inż. Jerzy Merkisz

email: jerzy.merkisz@put.poznan.pl

tel. 61 665 22 08

Faculty of Civil and Transport Engineering

ul. Piotrowo 3, 60-965 Poznan

Responsible for the course/lecturer:

prof. dr hab. inż. Andrzej Frąckowiak

email: andrzej.frackowiak@put.poznan.pl

tel. 61 665 2779

Faculty of environmental and power engineering

ul. Piotrowo 3A, 60-965 Poznan

Prerequisites

The student possesses basic knowledge in the field of mathematics, physics and fluid mechanics as well as the ability to deepen understanding and interpretation of the transmitted messages and effective self-education in the field related to the chosen field of study. Is aware of the need to expand their competences, readiness for individual work and cooperation within the team. The student is able to determine the priorities important in solving the tasks set before him. Is aware of the social and economic importance of environmental protection.

Course objective

Students gain basic knowledge and skills in solving thermodynamic issues. They learn selected

theoretical results in the field of fluid mechanics. They will learn about different fluid models (Newtonian and non-Newtonian) and their behavior during flow. They will learn about selected issues of numerical modeling of fluid flow, as well as the basic concepts of environmental protection and the main ecological threats associated with the use of technical means of transport and possible remedial actions. Pro-ecological attitudes of students are shaped.

Course-related learning outcomes

Knowledge

1. Knows the concepts of environmental protection and ecology and related concepts, the structure of the biosphere and the properties of its individual elements. He knows the threats to the environment associated with the functioning of individual transport sectors.

2. Knows the main principles of preventing automotive pollution and basic legal acts regarding environmental protection in Poland and the European Union.

3. Knows issues in the field of technical thermodynamics, ie the theory of thermodynamic transformations, heat flow, heat and cooling machines.

4. 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

1. Is able to make a basic ecological evaluation of means of transport

2. Is able to propose actions to alleviate the negative environmental impact of transport

3. Is able to list and justify the ecological of development directions of transport systems and the environmental impact of the automotive industry

4. Is able to properly plan and perform experiments, including computer measurements and simulations, interpret the results obtained, and correctly draw conclusions from them

5. is able to carry out elementary technical calculations in the field of thermodynamics, such as heat and mass balances

Social competences

1. Understands the need for lifelong learning; can inspire and organize the learning process of others

2. Has increased environmental awareness

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The lecture ends with an exam on all material. The final credit for the laboratory classes is obtained on the basis of submitted reports, test colloquium.

Programme content

Statics, basic equations, laws of statics: equation equation, manometric formula, Pascal's law, Archimedes' law. Pressure on flat and curved walls. Basic equations of fluid dynamics: Bernoulli equation, instruments for measuring fluid velocity. Viscous fluid dynamics. Navier-Stokes equation. Bernoulli equation for real liquid. Friction Loss Factor. Local loss rate. Selected issues of viscous fluid flow. Selected issues of numerical fluid mechanics. Modeling of fluid mixing in a static mixer. Closed and open thermodynamic systems. Basic thermodynamic concepts. Gas thermometer. Thermal state equation. Reversible and irreversible changes. The first law of thermodynamics for a closed system. Status functions. Internal energy, enthalpy. 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 changes. Thermodynamic cycles. Heat conduction, forced and free convection, heat radiation. Fourier's law, Newton's formula and Stefan and Boltzmann's law, - One-dimensional fixed heat conduction and transfer: flat and cylindrical partition. Introduction to environmental protection and ecology, basic environmental hazards from transport, the impact of consumables on transport pollution, the mechanism of formation and methods of reducing the emission of toxic exhaust components, exhaust gas purification, measurement methods and standards of toxic compounds emission, generation and reduction of noise and vibrations in transport, environmental hazards when transporting dangerous goods, recycling of vehicles and their assemblies and components, energy consumption in transport, transport and climate warming, methods of valuation of environmental losses caused by transport, main assumptions of sustainable transport

Teaching methods

Informative lecture (information transfer in a systematic way by means of presentation)

Laboratory method (students conduct experiments independently)

Practice method (solving tasks, consolidating knowledge of lectures in practical form)

Bibliography

Basic

1. M.Ciałkowski Mechanika płynów, Wyd. Politechniki Poznańskiej, P-ń 2000

2. M.Ciałkowski Mechanika płynów. Zbiór Zadań z rozwiązaniami, Wyd. Politechniki Poznańskiej, P-ń 2008

3. Z. Orzechowski, P. Wiewiórski Ćwiczenia audytoryjne z mechaniki płynów, Wyd. Politechniki Łódzkiej, Łódź 1993

4. W.J. Prosnak Równania klasycznej mechaniki płynów, PWN 2006

5. Tuliszka E.:Termodynamika Techniczna, PWN, Poznań 1978.

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7. J. Gronowicz: Ochrona środowiska w transporcie lądowym. Wyd. Instytutu Technologii i Eksploatacji, Poznań ? Radom, 2003.

8. J. Merkisz: Ekologiczne Problemy silników spalinowych, Tom I i II. Wyd. Politechniki Poznańskiej, Poznań, 2000.

9. J. Merkisz, J. Pielecha, S. Radzimirski: Pragmatyczne podstawy ochrony powietrza atmosferycznego w transporcie drogowym. Wyd. Politechniki Poznańskiej, Poznań, 2009.

Additional

1. J.A. Kołodziej Podstawy mechaniki płynów, Wyd. Politechniki Poznańskiej, P-ń 1982

2. J. Walczak Inżynierska mechanika płynów, Wyd. Naukowo-Techniczne, 2010

3. B. Dobrzańska, G. Dobrzański, D. Kiełczowski: Ochrona środowiska przyrodniczego. Wyd. Naukowe PWN, Warszawa 2008.

4. S. Zięba: Historia myśli ekologicznej. Wyd. KUL, Lublin 2004

5. Szargut J.: Termodynamika, PWN, Warszawa 1998

6. Szargut J.: Termodynamika techniczna, PWN, Warszawa 1991

7. Szargut J. i in.: Programowy zbiór zadań z termodynamiki technicznej, PWN, Warszawa 1986

Breakdown of average student's workload

	Hours	ECTS
Total workload	195	7,0
Classes requiring direct contact with the teacher	105	3,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, reports preparation)[1]	90	3,5

[1] delete or add other activities as appropriate