COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fluid mechanics [S1Energ2>MP]

Course

Field of study
Power Engineering

Year/Semester
1/2

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
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

Number of credit points

5,00

Coordinators

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

Lecturers

mgr inż. Karolina Wyżkiewicz
karolina.wyzkiewicz@put.poznan.pl

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

dr inż. Michał Gołębiewski
michal.golebiewski@put.poznan.pl

dr inż. Łukasz Semkło
lukasz.semklo@put.poznan.pl

Prerequisites

Mathematics and physics news in the field of study program. The student is able to describe the basic physical phenomena and perform calculations related to them. 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 acquired knowledge and skills.

Course objective

To familiarize students with the theoretical foundations and applications of fluid mechanics.

Course-related learning outcomes

Knowledge:
1. Has advanced knowledge in the field of fluid mechanics, including the knowledge necessary to understand the basic physical phenomena occurring in elements and systems of fluid machines, and in their environment.

Skills:
1. Is able to obtain information from literature, databases and other sources; is able to integrate the information obtained, interpret it, as well as draw conclusions, formulate and justify opinions.

Social competences:
1. Is aware of the critical assessment of knowledge and recognizes its importance in solving cognitive and practical problems.
2. Is aware of the importance of behaving in a professional manner, observing the principles of professional ethics and promoting standards of ethical and responsible conduct of research and implementation activities in the energy industry; is aware of the care for the achievements and tradition of the profession, as well as respect for the diversity of views and cultures.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: written exam, number of questions (topics) 5 - 10.
Exercises: 2 tests, number of tasks to be solved from 3 to 6, the condition for passing is a positive grade in both tests.
Laboratories: tests and evaluation of reports. The condition for passing is a positive assessment of all reports

Programme content

Models of continuous media, forces acting on fluids, fluid statics and dynamics, as well as fundamental equations such as Bernoulli's equation and the Navier-Stokes equation. The application of instruments for measuring mass flow rate, analysis of compressible fluid flow, classification of flows, and an introduction to computational fluid dynamics (CFD) and flow modeling in Ansys CFX.

Course topics

Subject of fluid mechanics. Continuous medium model. Forces acting on the fluid. Fluid statics. Euler's fluid equilibrium equation. Pressure of fluid on the walls of solid bodies. Pascal's law. Archimedes' law. Manometric formula. Basic theorems of fluid kinematics. Streamlines. Stream surface. The path of the fluid element. Acceleration of the fluid element. Substantial, convective and local derivative. Dynamics of an ideal fluid. Bernoulli's equation and its applications. Instruments for measuring the mass flow of flowing fluid: Pitot tube, Prandtl probe, Ventouri tube. The reaction exerted by the fluid on the canal walls. Angular momentum. Water turbines. Fluid flow with losses. Classification of flow losses. Bernouli equation with losses. Hydraulic radius. Basic equations of fluid dynamics. Stress tensor. Reynolds Transport Theorem. Principle of conservation of mass. Principle of conservation of momentum and angular momentum. The principle of conservation of energy. Compounds constitutive of a fluid. Newton's concept of viscosity. Navier Stokes equation. Examples of solutions to the NS equation: Couett flow, Hagen-Poiseuille flow. Determination of the viscosity coefficient of a fluid. Similarity of flows. Similarity numbers. Compressible fluid flow. Flow classification. Energy equation. Stagnations parameters, critical parameters. Gas velocity measurement. Fundamentals of numerical fluid mechanics. Fluid flow modeling in the Ansys CFX environment: fluid flow in a static mixer, stator rotor system, flow around bodies.

Teaching methods

1. Lecture: multimedia presentation and on the board.
2. Exercises: examples analyzed on the board and self-made by students. Pass:.
3. Laboratories: presentation of the content and course of research, supervision over their implementation.

Bibliography

Basic:
1. Ciałkowski M., Mechanika Płynów. Skrypty Uczelniane. Wydawnictwo Politechniki Poznańskiej.
2. Kołodziej J., Mechanika Płynów. Skrypty Uczelniane. Wydawnictwo Politechniki Poznańskiej.
3. Ciałkowski M. (red.) Mechanika płynów. Zbiór zadań z rozwiązaniami. Wydawnictwo Politechniki Poznańskiej, Poznań 2008.
4. Prosnak W.J. Mechanika Płynów, t. I. PWN Warszawa 1971.

Additional:
1. Gołębiewski C., Łuczywek E., Walicki E., Zbiór zadań z mechaniki płynów, PWN Warszawa 1978.

Breakdown of average student's workload

	Hours	ECTS
Total workload	132	5,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	70	2,50