COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fluid mechanics [N1MiBM2>MP]

Course

Field of study
Mechanical Engineering

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
part-time

Requirements
compulsory

Number of hours

Lecture
16

Laboratory classes
8

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

Lecturers

Prerequisites

Basic knowledge of physics, mathematics, classical mechanics, vector calculus, calculus.

Course objective

Providing students with basic knowledge of fluid mechanics, in the field of statics, kinematics and dynamics, which will enable them to study further subjects. The student acquires the ability to solve basic problems of fluid mechanics

Course-related learning outcomes

Knowledge:
The student has basic knowledge of fluid mechanics, covering issues of statics, kinematics and dynamics.
The student can recognize the phenomena in technic and environment dealing fluid mechanics,

Skills:
The student has the ability to self-study using modern teaching tools, such as remote lectures, websites, databases, e-books, etc.,
The student is able to obtain information from literature, the internet, databases and other sources, is able to integrate obtained information, interpret and draw conclusions from it.
The student can solve the basic problems of fluid mechanics.

Social competences:
The student is able to properly set priorities for implementation of the task specified by himself or others based on available knowledge.
The student understands the need for critical assessment of knowledge and continuous education.
The student is aware of the importance and understands the non-technical aspects and effects of engineering activities, including its impact on the environment, and the associated responsibility for decisions made.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Credit for the lecture based on the final colloquium. Credit threshold: 50%.
Laboratory classes: Credit for laboratory exercises on the basis of colloquia and activity in class. Passing threshold: 50% of the points possible on colloquia and activity.

Programme content

Lecture:
- Properties of a fluid: density, specific gravity, specific weight, viscosity, bulk modulus, surface tension, volumetric extension, speed of sound
- Differential equation of fluid equilibrium in the field of gravity, examples of integration of the equilibrium equation, manometric formula, pressure at great depths, pressure and temperature in the earth's atmosphere
- Fluid thrust on flat and curved surfaces of solids, Archimedes' law, conditions for steady swimming, relative equilibrium-fluid kinematics; Lagrange's and Euler's description, material derivative, flow visualizations, Reynolds transport theorem
- Dynamics of ideal fluids; mass balance, equation of continuity of flow (local and global form), Bernoulli equation, measurement of velocity and flow rate
- fluid outflow through a hole (Torricelli's formula), momentum in systems with flow, dynamic response of a jet
- Real fluid dynamics; energy equation, laminar and turbulent flow, pump and turbine in a hydraulic system,
- Calculation of flow in a rectilinear section of pipe, Darcy formula (calculation of flow rate, selection of diameter, etc.).
- External flow; drag force and lifting force
- Fluid flow in an open channel;
- Compressible flows; enthalpy,fluid properties at the point of stagnation, isentropic flow, Mach number, speed of sound, Laval nozzle,
- Differential analysis of flows,continuity equation, current function, Cauchy equation, Navier-Stokes equation.

Laboratory classes:
1.Measurement of fluid viscosity, calculation of basic hydrodynamic parameters of a sliding bearing.
2.Calculation of thrust force on flat walls of tanks.
3.Iterative calculation of the coefficient of friction loss, calculation of pressure drop in a rectilinear pipe section.
4.Calculation of the flow rate in a rectilinear section of the pipe, the velocity of liquid outflow from the tank through the pipe.
5.Selection of pipe diameter for a given flow rate.
6.Resistance force of streamlined bodies, calculation of the speed of descent of a body in a stationary fluid, calculation of dangerous wind speed for a steel chimney.
7.Calculation of flows in open channels, calculation of flow rate in typical channels, calculation of water depth in a channel with rectangular, trapezoidal, triangular and circular cross sections.
8.Calculation of isothermal flow of gas in a rectilinear section of a pipe, calculation of the discharge of gas from a tank.

Course topics

none

Teaching methods

Lecture: multimedia presentation illustrated by movies, animations and solving of tasks related to fluid mechanics.
Laboratory: solving of tasks, programming, discussion.

Bibliography

Basic:
1. K.Jeżowiecka-Kabsch, H.Szewczyk, Mechanika płynów, OWPW, Wrocław, 2001 [in Polish]
2. E.S.Burka, T.J.Nałęcz, Mechanika płynów w przykładach: teoria, zadania, rozwiązania, PWN, Warszawa, 2002 [in Polish]
3. R.Gryboś, Zbiór zadań z mechaniki płynów, WPŚ, Gliwice, 2000 [in Polish]
4. J.A.Kołodziej, M.Mierzwiczak, R.Starosta, Przewodnik do laboratorium komputerowego z mechaniki i biomechaniki płynów, WPP, Poznań, 2012 [in Polish]
5. Y.A.Cengel, J.M.Cimbala, Fluid mechanics: fundamentals and applications, McGraw Hill, Singapore, 2014

Additional:
1. Z.Orzechowski, J.Prywer, Mechanika płynów w inżynierii i ochronie środowiska, WNT, Warszawa 2009 [in Polish]
2. Z.Orzechowski, J.Prywer, Zadania z mechaniki płynów w inżynierii i środowiska, WNT, Warszawa 2001 [in Polish]
3. J.Walczak, inżynierska mechanika płynów, WPP, Poznań, 2006 [in Polish]
4. R.A.Duckworth, Mechanika płynów, WNT, Warszawa, 1983 [in Polish]

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	24	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	51	2,00