Course description

1 General information

Course name	Fluid Mechanics
Course code	M5-FM
Level of study (B.Sc, M.Sc., Ph.D.)	B.Sc.
ECTS	5
Course manager	Dr inż. Stanisław Walczak, Institute of Thermal and Process Engineering, M-05
Course length	One (1) semester
Coordinator for international programs	erasmus@mech.pk.edu.pl

2 Prerequisites

- completed courses in mathematics and physics

3 Program

makrType	Lectures	Classes	Labs	Computer labs	Project	Seminar
Hours	15	30	15	0	0	0

4 Contents

Lectures		
No.		Hours
1	Basic concepts. Macroscopic properties of fluids.	1
2	An idealized fluid model. Forces acting on the fluid. Fluid Statics: Euler's theorem. Fluid equilibrium differential equations. Equilibrium of fluid placed in the earth gravity field. Fluid in the state of relative equilibrium.	2
3	Pascal's law. Hydrostatic forces acting on plane and curved surfaces. Hydrostatic buoyancy.	2
4	Stability of floating bodies entirely and partially immersed in a liquid. Metacenter height.	2
5	Fluid kinematics. The pathline, streamline streakline definitions. Continuity equation. Volumetric and mass flow rate.	2
6	Differential equations of perfect fluid motion. Bernoulli integral.	1
7	Application of Bernoulli equation: Local velocity measurements using Pitot tube; Steady and time-dependent outflow of liquid from the tank through a small hole; Siphon phenomenon	2
8	Classical Reynolds Experiment; Laminar and turbulent flows. Velocity and shear stress distribution of lamina flow. Frictional loos on pipes. Bernoulli equation for real liquid.	3

Classes		
No.		Hours
1	Equations of equilibrium – Euler’s Equations	4
2	Total and relative equilibrium in the field of potential body forces.	4
3	Assignation of hydrostatic forces acting on plane and curved surfaces.	6
4	Hydrostatic buoyancy. Stability of floating bodies entirely and partially immersed in a liquid.	4
5	One dimensional perfect fluid flow. Application of Bernoulli equation.	2
6	Time of outflow of liquid from vessel.	5
7	Flow of real liquid in open and closed channels. Friction and local losses.	5

Labs		
No.		Hours
1	Measurements of the fluid viscosity	2
2	Fluid outflow through the small orifice	2
3	Classic Reynolds Experiment	2
4	Measurement of local and average value of fluid velocity in straight circular pipes	2
5	Measurement of pressure losses caused by viscosity	2
6	The pressure losses caused by the local obstacle	2
7	Flow measurements	2

5 Learning Outcomes (skills and knowledge):

- The student is able to define the fluid concept and the basic concepts concerning fluid in state of equilibrium and motion.
- The student can determine the directions of hydrostatic forces.
- The student is able to derive Euler's equation and Bernoulli's equation.
- The student can give basic equations defining the perfect fluid motion.
- The student is able to classify viscous fluid flows.
- The student is able to present and interpret Navier-Stokes equations.

6 Assessment policy (examination):

- Passed theoretical (lecture) exam
- Passed practical (classes) exam
- Passed laboratory reports
- The final grade is evaluated as the weighted average of grades from: the laboratory reports (0.2), practical exam (0.4) and theoretical exam (0.4)

7 Literature

1. B. R. Munson, D. Young, T. Okiishi, Fundamentals of Fluid Mechanics, J. Wiley& Sons.
2. Y. Nakayama & R.F. Boucher, Introduction to Fluid Mechanics, Elsevier.
3. W. P. Graebel, Advanced Fluid Mechanics, Elsevier.