module title: **Fluid Mechanics**		
field of study: **Mechanical Engineering**	type of study: **full-time**	course code: **B5_11**
course: **Computer Modelling & Simulation**	degree: **Bachelor (BSc)**	year: **II** semester: **IV**
type of classes: **lecture, tutorials, laboratory**	hours per semester: **30LE, 30T, 15Lab**	No of ECTS credits: **6**

MODULE DESCRIPTION

TARGETS

T1. Understanding the fundamental properties of fluids, properties of pressure as a scalar quantity, hydrostatic pressure and hydrostatic forces.
T2. Understanding various methods of fluid motion description, understanding basic properties of fluid motion for ideal and viscous fluids.
T3. Ability to use the one dimensional theory of fluid motion for ideal and viscous fluids to solve practical problems.

PREREQUISITES & ADDITIONAL REQUIREMENTS

R1. Knowledge on the mathematical analysis and physics.
R2. Knowledge from the basic course of mechanics.
R3. Capability to use various information sources, including technical manuals.
R4. Capability of individual work.
R5. Data analysis and presentation of results

LEARNING OUTCOMES

LO1. Knowledge on fundamentals of fluid statics.
LO2. Knowledge on the fundamentals of fluid kinematics and dynamics of ideal fluids.
LO3. Knowledge on fundamentals of dynamics of viscous fluids.
LO4. Knowledge of basic fluid properties and ability to use them in solving practical problems.
LO5. Knowledge of basic rules concerning the equilibrium of steady fluid and ability to use them in solving practical problems.
LO6. Knowledge of basic rules concerning the hydrostatic pressure and hydrostatic forces acting on plane and curved surfaces, ability to use them in solving practical problems.
LO7. Knowledge on fundamentals of analytical description of fluid motion and ability to use them in solving practical problems.
LO8. Knowledge of Bernoulli and continuity equations for 1D flow of ideal fluid and ability to use them for measurement of pressure and velocity.
LO9. Knowledge of Bernoulli and continuity equations for 1D flow of ideal fluid and ability to use them in solving practical problems.
LO10. Knowledge of linear momentum equations for 1D flow of ideal fluid and ability to use them for calculation of forces acting on fluid element.
LO11. Knowledge of Bernoulli and continuity equations for 1D flow of viscous fluid and ability to use them to determine hydraulic losses in pipelines.

TEACHERS

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academic teachers:

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- dr inż. Dariusz Asendrych - darek@imc.pcz.czest.pl

MODULE CONTENT

LECTURE	hours
L 1-4 - Basic concepts: solid body versus fluid mechanics, fluid as a continuum, basic physical properties of fluids, action of normal and shear forces upon the fluid element, viscosity as a physical property of fluids and the property of fluid motion.	4
L 5-6 – Equilibrium of steady fluid: equilibrium equation of steady fluid in gravity field	2
L 7-10 – Connected vessels principle: liquid manometers, atmospheric pressure, reference level for pressure measurement, Pascal's law.	4
L 11-16 - Hydrostatic forces: hydrostatic forces acting on plane and curved surfaces, hydrostatic forces acting on immersed bodies, equilibrium of immersed and floating bodies.	6
L 17-20 - Description of fluid motion: Lagrange and Euler's description of fluid motion, fluid element trajectory and streamline, streamtube, continuity condition, Euler's and N–S equations and their solution methods.	4
L 21-24 - Bernoulli equation for ideal fluids: Bernoulli equation along the streamline for ideal fluid, measurement of flow velocity with pressure tubes.	4
L 25-26 - Bernoulli equation for viscous fluids: energy losses in viscous fluid, major and minor losses, interpretation of energy transformations in flow of viscous fluid	2
L 27-30 – Flow of viscous fluid in a pipeline: flow in a non- circular ducts, iterative calculation of flow losses, flows through long pipelines, finding the correct pipe diameter for a given fluid flux, flow through a pipeline network	4
Σ	**30**

TUTORIALS	hours
T1-4 - Basic physical properties of fluids	4
T5-8 - Equilibrium of steady fluid	4
T9-10 - Pascal's law	2
T11 -12 - Hydrostatic forces acting on plane arbitrarily oriented surfaces	2
T13-16 - Hydrostatic forces acting on curved surfaces	4
T17-19 - Flow kinematics	3
T20-22 - Bernoulli equation for ideal fluids	4
T23-26 - Linear momentum equations for 1D flow of ideal fluid	3
T27-30 - Bernoulli equation for viscous fluids	4
Σ	**30**

LABORATORY	hours
L1 - Measurements of basic flow parameters by pressure tubes and taps	1

L2 - Flow around the circular cylinder	1
L3-4 - Drag coefficient of streamlined and bluff bodies	1
L5 - Determination of the volumetric -rate correction factor (Coriolis coefficient)	1
L6 - Determination of axisymmetric diffuser efficiency	1
L7 - Characteristics of the nozzle flow fed from the open tank	1
L8 - Determination of net reaction force upon the fixed het turning vane	1
L9 - Determination of the critical Reynolds number for circular pipe flow	1
L10 - Energy losses in the flow through a pipeline	1
L11 - Determination of the characteristic parameters for the flow through a weir	1
L12 - Verification of Stevin's theorem	1
L13 - Determination of hydrostatic force and its application point for arbitrarily oriented flat surfaces	1
L14 - Determination of a metacentric height for floating bodies	1
L15 - Measurement of flow velocity in a pipeline, determination of hydrostatic pressure, verification of Boyle – Marriot law	1
Σ	**15**

TEACHING TOOLS

1 - Lecture with Power Point presentation, lecture notes, sample problems
2 - Tutorials with Power Point presentation, tutorial book
3 - Laboratory exercises, written report
4 - Laboratory tutorials
5 - Experimental rigs and measuring equipment

SOURCE LITERATURE

1. Drobniak S.: Fluid Mechanics – An Introduction, TEMPUS PROJECT, TUCz publication, 2002.
2. E.J. Shaughnessy, I.M. Katz, J.P. Schaffer, Introduction to Fluid Mechanics, Oxford University Press, 2005
3. F.M. White, Fluid Mechanics, McGraw-Hill, 2003
4. J.B. Evett, C. Liu, Fundamentals of Fluid Mechanics, McGraw-Hill, 1987
5. Durst F.: Fluid Mechanics. An introduction to the theory of fluid flows. Springer-Verlag, Berlin, 2008