Course code **Course item**

1. INFORMATION ABOUT THE COURSE

a. Basic information

Course title	***Fluid dynamics***
Field of study	*Mechanical Engineering*
Cycle	*first degree*
Study profile	*General academic*
Study mode	*full-time*
Specialisation	–
Unit responsible for the field of study	*Faculty of Mechanical Engineering, Department of Mechanics and Computer Methods*
Lecturer	*Emil Smyk, PhD*
Introductory courses	–
Prerequisites	–

b. Semester/ weekly timetable

Semester	Lectures (W)	Classes (C)	Laboratories (L)	Project classes (P)	Seminars (S)	Fieldwork (T)	ECTS credits ECTS*
winter /summer	15	15	15				

C. Assumed outcomes and aims - aims bind the course programme with the study programme and are referred to in learning outcomes point 2

2. LEARNING OUTCOMES (acc. to National Qualifications Framework)

No.	Description of learning outcomes	Reference to learning outcomes for the field of study	Reference to learning outcomes for the area of study
KNOWLEDGE			
K1	The student has knowledge of formulating and solving simple problems in fluid mechanics, particularly fluid statics, closed flows, and turbomachinery. He or she understands the theoretical foundations of flow.	MBM_O1_K_W01, MBM_O1_K_W02, MBM_O1_K_W04, MBM_O1_K_W11	P6S_WG, P6S_WG_inż, P6S_WG, P6S_WG_inż, P6S_WG, P6S_WG_inż, P6S_WG P6S_WG_inż
K2	Understands the impact of engineering activities on the environment, in particular the impact of industrial activities on the greenhouse effect.	MBM_O1_K_W13, MBM_O1_K_W15	P6S_WG, P6S_WK
Skills			

S1	Is able to measure thermodynamic values in liquids and use catalog cards and operating instructions.	MBM_O1_K_U01, MBM_O1_K_U12	P6S_UW, P6S_UW_inż, P6S_UU
SOCIAL COMPETENCES			
SC1	The student is able to work in a group during research and understands the scope of his/her competences	MBM_O1_K_K01, MBM_O1_K_K02	P6S_KK, P6S_KK

3. TEACHING METHODS

multimedia lecture, project, design classes, presentation, discussion, case study

4. METHODS OF EXAMINATION

class attendance, final test, preparation of reports

5. **COURSE CONTENT**

Specify the content separately for each type of classes in accordance with point I.B.

Lectures:
Divisions of fluid mechanics. Differences between solids, liquids, and gases. The concept of a fluid. The model of a continuous medium. The fluid element. Properties of fluids. Density, specific gravity. Compressibility. Thermal expansion. Viscosity. Forces acting on a fluid: bulk and surface. Relative equilibrium of a fluid. Fluid pressure on plane and curved walls of solids. Flotation and stability of floating bodies fully and partially immersed in a fluid. Archimedes' principle. Hydrostatic buoyancy. Methods of studying fluid motion. Lagrange's and Euler's methods. Streamline. Path of a fluid element. Volumetric flow, mass flow. Circulation of the velocity vector. Local fluid motion - translational, rotational, and deformational motion of an element. Bernoulli's equation. Applications of Bernoulli's equation. Principle of conservation of mass. Equation of flow continuity. Principle of conservation of momentum and angular momentum. Principle of conservation of energy. Buckingham Pi theorem.

Classes
Fluid statics: measuring pressure, calculating fluid acceleration, pressure on curved and flat surfaces. Kinematics and dynamics: simple velocity measurements, Venturi tube, and applications of Bernoulli's equation.

Laboratories:
Implementation of the laboratory exercises selected during the first session:

Pressure measurements using hydrostatic manometers,

- *Air flow measurement,*
- *Velocity and pressure field measurements using impact probes,*
- *Velocity profile in a circular tube,*
- *Classical Reynolds experiment,*
- *Pressure losses in closed ducts due to fluid viscosity,*
- *Pressure losses in closed ducts due to local obstacles,*
- *Series and parallel operation of fans,*
- *Relative equilibrium of fluids,*
- *Determination of flow curves for viscous non-Newtonian fluids,*
- *Measurements of fluid viscosity,*
- *Total energy line, piezometric line,*
- *Hydrodynamic pressure,*
- *Plane and axisymmetric flow around bodies in a real fluid,*

	• *Visualization of flow around bodies,* • *Hydrostatic pressure,* • *Application of hydraulic analogy to the study of plane supersonic flows,* • *Ratio of average velocity to maximum velocity of fluid flow in a circular tube.*

6. VALIDATION OF LEARNING OUTCOMES

(Each learning outcome from the list requires validation methods to ensure that it was achieved by a student.)

Learning outcome	Form of assessment (for example:)					
	Oral examination	Written examination	Test	Project	Report	Class attendance
W1 – W2			x			
S1			x			x
SC1					x	x

7. LITERATURE

Basic literature	*Cengel, Y. A. (2010). Fluid mechanics. McGraw-Hill Education*
Supplementary literature	*Cengel Y. A, Boles M., 2005 Thermodynamics: An Engineering Approach, Mcgraw-Hill 5th Edition*

8. TOTAL STUDENT WORKLOAD REQUIRED TO ACHIEVE EXPECTED LEARNING OUTCOMES EXPRESSED IN TIME AND ECTS CREDITS

Student's activity		Student workload– number of hours (for example:)
Classes conducted under a direct supervision of an academic teacher or other persons responsible for classes	Participation in classes indicated in point 2.2	45
	Supervision hours	5
Student's own work	Preparation for classes	10
	Reading assignments	5
	Other (preparation for exams, tests, carrying out a project etc)	15
Total student workload		80
	Final number of ECTS credits	4