POZNAN UNIVERSITY OF TECHNOLOGY
EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)
pl. M. Skłodowskiej-Curie 5, 60-965 Poznań

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fluid Mechanics 1

Course

Field of study
Environmental Engineering

Year/Semester
1/2

Area of study (specialization)

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
20	0	0
Tutorials	Projects/seminars	
10	0	

Number of credit points

6

Lecturers

Responsible for the course/lecturer:
prof. Janusz Wojtkowiak, Ph.D., Dr.SC. Eng.

Responsible for the course/lecturer:

Prerequisites

Mathematics: algebra - functions, equations and inequalities, plane and space geometry, plane and space geometry, trigonometry, analytic geometry, equations and systems of equations, elements of differential and integral calculus of functions of one variable. Physics: fundamental lows of physics, rules of mass momentum and energy conservation in classical mechanics, statics, kinematics, dynamics of solid body, hydraulics.

Course objective

Purchase by the students basic knowledge and skills in fluid mechanics necessary to solve common tasks of fluid flows occurring in the build and natural environment.

Course-related learning outcomes

Knowledge

1. The students knows physical quantities characterizing fluids, understands their physical meaning and knows their units

2. The student has knowledge of hydrostatic force on plane and curved surfaces

3. Student knows and understands equations describing force and torque by the flow on the walls

4. The student has an elementary knowledge of the laws governing the operation of turbomachinery (pumps, funs, blowers and compressors)

5. The student has ordered knowledge of the phenomena responsible for the loss of pressure in the pipes and fittings and knows the equations used to describe them

6. The student has a basic knowledge necessary for modeling the flow of water in the soil

7. The student knows and understands the phenomena occurring during the flow in open channels (free surface flow) and knows equations describing these phenomena

8. The student knows and understand the laws describing liquid flows from the tanks

Skills

1. The student can apply and convert units of physical quantities used in fluid mechanics

2. The students can calculate: hydrostatic forces on plane and curved surfaces of the tanks, the forces of dynamic interactions between flowing fluid and pipe walls and immersed bodies, the power and efficiency of turbomachines, pressure losses in straight pipes and fittings, the pressure differences that cause a chimney effect and natural ventilation

3. The student can calculate: flow rates in free surface flows, optimal shapes of channels in free surface flows, discharge time of tanks and vessels

Social competences

1. The student understands the need for teamwork in solving theoretical and practical problems

2. The student sees the need for systematic increasing his skills and competences

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Final exam: discussion about correctness of homework problem solutions; the student has to justify each of his decision and, in that way, confirm his knowledge and skills.

Programme content

Basic information. Classification of fluids. Newtonian and non-newtonian fluids. Shear stress in the fluid, the perfect fluid and viscous fluid. Basic physical properties of fluids. Effect of temperature and pressure on parameters of fluids. Fluid statics. The basic equation of fluid statics. The hydrostatic pressure. Absolute pressure, gauge pressure, vacuum. Archimedes low. Hydrostatic force on plane and curved surfaces. Internal fluid flows. The equation of continuity. Local velocity and average velocity of the fluid. The velocity distribution. Friction pressure losses. Laminar and turbulent flows. Critical Reynolds number. Bernoulli equation for inviscit and viscous fluids. Friction factor. Darcy-Weisbach formula. Hagen and Blasius formulas. Roughness of the pipe, Moody chart. Colebroock-White, Walden and Haaland formulas. Minor pressure loss. Calculation of pressure losses in complex hydraulic systems.

Momentum of the fluid. Force and torque by the flow on the walls. Orifice flow, tank discharge. Weirs. Open channel flows. Chezy formula. Manning roughness coefficient. Subcritical and supercritical free surface flows. Froude number. Optimal shape of open channel cross-section. Flows in porous media. Underground water motion. Water inflow to traditional and artesian wells.

Teaching methods

Lectures: classical lecture with elements of conversation.

Tutorial: solving problems (20% during tutorials, 80% as a homework).

Bibliography

Basic

1. Munson B.R., Young D.F., Okiishi T.H., Fundamentals of Fluid Mechanics (4rd. Ed.). John Wiley and Sons Inc., New York 2002.

2. White F.M., Fluid Mechanics. McGrawHill Book Company. 5th Int. Ed. Boston 2003.

Additional

3. Bloomer J.J., Practical Fluid Mechanics for Engineering Applications. Marcel Dekker, Inc, New York, Basel 2000.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,0
Classes requiring direct contact with the teacher	35	1,5
Student's own work (literature studies, preparation for tutorials, problem solving - homework, preparation for exam [1]	115	4,5

[1] delete or add other activities as appropriate