COURSE DESCRIPTION CARD - SYLLABUS

Course name
Fluid mechanics [S1BZ1E>MP]

Course

Field of study
Sustainable Building Engineering

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

2,00

Coordinators

prof. dr hab. inż. Janusz Wojtkowiak
janusz.wojtkowiak@put.poznan.pl

Lecturers

Prerequisites

Mathematics: algebra - functions, equations and inequalities, plane and space geometry, trigonometry, analytic geometry, equations and systems of equations, elements of differential and integral calculus of functions of one variable at a level 5/6 KRK. Physics: fundamental lows of physics, rules of mass momentum and energy conservation in classical mechanics, statics, kinematics, dynamics, and hydraulics at level 5 KRK

Course objective

Purchase by the students basic knowledge and skills in fluid mechanics necessary to solve common tasks of fluid flows occurring in civil engineering and built 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
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

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
3. The student can calculate: pressure losses in straight pipes and fittings, the pressure differences that cause a chimney effect and natural ventilation
4. The student can calculate flow rates in free surface flows, optimal shapes of channels in free surface flows

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:

Learning outcomes presented above are verified as follows:
Lectures:
Final written knowledge test consisting of 4 questions. Test duration: 45 minutes. Term of the test: last lecture during the semester. Continuous assessment during lectures (rewarding activity of the students).
Tutorials
One written tests during the semester - at the end of the semester. Continuous assessment of the students (rewarding students activity).
To pass the tests there is necessary to obtain at least 50% of the maximum points (max=20 points).
Grading system:
0-9 points = 2,0 (failed); 10-12 points = 3,0 (sufficient); 13-14 points = 3,5 (sufficient plus); 15-16 points = 4,0 (good); 17-18 points = 4,5 (good plus); 19-20 points = 5,0 (very good).

Programme content

The module program covers the following topics:
1. fluid classification,
2. basic thermophysical properties of fluids,
3. basic equation of fluid statics,
4. continuity equation,
5. energy conservation equation, Bernoulli equation,
6. internal fluid flows,
7. pressure losses in pipes and fittings,
8. liquid flow in a porous medium, water flow in the ground,
9. flows in open channels.

Course topics

The lecture program covers the following topics:
1. Newton's hypothesis, shear stress in a fluid, ideal fluid, real fluid,
2. basic equation of fluid statics,
3. hydrostatic pressure, absolute pressure, vacuum, gage pressure,
4. fluid force on flat and curved walls,
5. local velocity and average velocity of the fluid,
6. average mass velocity of the fluid,
7. laminar and turbulent flows, critical Reynolds number, Bernoulli's equation for ideal and real fluids.
8. friction pressure losses, Darcy-Weisbach formula, Moody (Nikuradsego) diagram, Colebroock-White formula, Walden formula, Haaland formula,

9. minor pressure losses,
10. Darcy's law, (filtration coefficients), efficiency of an ordinary well, depression cone,
11. free surface flows, uniform flow, Chezy's equation, hydraulic drop, Manning's formula, Manning's roughness coefficient, subcritical and supercritical flows, Froud's number, optimal cross-sections of open pipes,
12. hydraulic jump.

The tutorial program covers the following topics:
1. operation and applications of liquid manometers,
2. calculating the force of liquid pressure on flat and curved walls,
3. calculation of pressure losses in pipes and fittings,
4. calculation of pump and fan power,
5. determining the efficiency of an ordinary well,
6. calculation of the efficiency of open ducts,
7. calculating optimal shapes of open ducts.

Teaching methods

Classical lecture with elements of conversation
Tutorials: solving problems method

Bibliography

Basic
1. White F.M., Fluid Mechanics. McGrawHill Book Company. 5th Int. Ed. Boston 2003.
2. Munson B.R., Young D.F., Okiishi T.H., Fundamentals of Fluid Mechanics (4rd. Ed.). John Wiley and Sons Inc., New York 2002.
3. Bloomer J.J., Practical Fluid Mechanics for Engineering Applications. Marcel Dekker, Inc, New York, Basel 2000.
Additional
1. Mitosek M., Mechanika płynów w inżynierii i ochronie środowiska. WNT, W-wa 2014.
2. Orzechowski Z., Prywer J., Zarzycki R., Mechanika płynów w inżynierii i ochronie środowiska, WNT, W - wa 2009.
3. Jeżowiecka-Kabsch, Szewczyk H., Mechanika płynów, Politechnika Wrocławska, Wrocław 2001.

Breakdown of average student's workload

	Hours	ECTS
Total workload	55	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00