STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Fluid Mechanics		**1010134231010130197**

Field of study	Profile of study (general academic, practical)	Year /Semester
Environmental Engineering Extramural First-	**general academic**	**2 / 3**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**part-time**

No. of hours				No. of credits
Lecture: **14**	Classes: **12**	Laboratory: **-**	Project/seminars: **-**	**4**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
major	**from field**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**4 100%**
Technical sciences	**4 100%**

Responsible for subject / lecturer:

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Responsible for subject / lecturer:

dr inż. Ilona Rzeźnik (tutorials)
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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Mathematics: algebra - functions, equations and inequalities, plane and space geometry, trigonometry, analytic geometry, basic probability theory, 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
2	**Skills**	Solving algebraic equations and systems of algebraic equations, formulating physical problems in the language of mathematics, solving simple differential equations, the use of integral calculus to calculate the geometrical quantities (eg, surface areas) and physical quantities (eg, average values of velocity, momentum of inertia), solving typical problems in classical mechanics - statics, kinematics, dynamics and hydraulics.
3	**Social competencies**	Awareness of the need to constantly update and supplement knowledge and skills

Assumptions and objectives of the course:

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.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. The students knows physical quantities characterizing fluids, understands their physical meaning and knows their units (achieved during lectures and tutorials) - [[K_W03]]
2. The student has knowledge of hydrostatic force on plane and curved surfaces (achieved during lectures and tutorials) - [[K_W03, K_W07]]
3. Student knows and understands equations describing force and torque by the flow on the walls (achieved during lectures and tutorials) - [[K_W03, K_W07]]
4. The student has an elementary knowledge of the laws governing the operation of turbomachinery (pumps, funs, blowers and compressors) (achieved during lectures and tutorials) - [[K_W03, K_W04, K_W05]]
5. The student has basiced knowledge of the phenomena responsible for the loss of pressure in the pipes and fittings and knows the equations used to describe them (achieved during lectures and tutorials) - [[K_W02, K_W03, K_W05, K_W07]]

Skills:

1. The student can apply and convert units of physical quantities used in fluid mechanics (achieved during lectures and tutorials) - [[K_U01]]

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 (achieved during lectures and tutorials) - [[K_U01, K_U13]]

3. The student can calculate: pressure losses in straight pipes and fittings, the pressure differences that cause a chimney effect and natural ventilation, the pressure increase and velocity of pressure wave in water hammer phenomenon (achieved during lectures and tutorials) - [[K_U01, K_U13]]

Social competencies:

1. The student understands the need for teamwork in solving theoretical and practical problems (achieved during lectures and tutorials) - [[K_K03, K_K04]]

2. The student is aware of the need to repeat the measuring actions and to evaluate the uncertainty of measurement and calculation results (achieved during lectures and tutorials) - [[K_K05]]

3. The student sees the need for systematic increasing his skills and competences (achieved during lectures and tutorials) - [[K_K01]]

Assessment methods of study outcomes

Lectures (results W02, W03, W04, W05, W07, U01, U13)

Final written test at the end of the semester (45 min., 4 questions). List of questions is published at the beginning of the semester.

Continuous assessment during lectures (rewarding activity of the students.

To pass the final test as well as to pass the tutorials) 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)

Tutorials (results U01, U13)

Short written final test at the end of the semester (60 min., 2 problems to solve).

Continuous assessment of the students (rewarding students activity).

Course description

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.

The basic equation of fluid statics. The hydrostatic pressure. Absolute pressure, over-and underpressure. Archimedes low. The pressure distribution in the Earth atmosphere. The surface tension. Hydrostatic force on plane and curved surfaces. 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. Water hammer phenomenon. Orifice flow, tank discharge. Weirs.

Teaching method

Classical lecture with elements of conversation

Tutorials ? solving problems method

Basic bibliography:

1. Mitosek M., Mechanika płynów w inżynierii i ochronie środowiska. Warszawa, PWN 2001

2. Orzechowski Z., Prywer J., Zarzycki R., Mechanika płynów w inżynierii środowiska. Wyd. 2 zmienione. Warszawa, WNT 2001

3. Jeżowiecka-Kabsch K., Szewczyk H., Mechanika płynów. Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2001

4. Mitosek M., Matlak M., Kodura A., Zbiór zadań z hydrauliki dla inżynierii i ochrony środowiska. Oficyna wydawnicza Politechniki Warszawskiej, Warszawa 2004

5. Orzechowski Z., Prywer J., Zarzycki R., Zadania z mechanika płynów w inżynierii środowiska. Warszawa, WNT 2001

Additional bibliography:

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

Result of average student's workload	
Activity	**Time (working hours)**
1. Participation in lectures (contact hours)	14
2. Participation in tutorials (contact hours, practical training)	12
3. Participation in consultations related to the lectures and tutorials (contact hours)	3
4. Preparation for the final test of tutorials (autonomus learning)	25
5. Preparation for the semester test of lectures (autonomus learning)	21

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	100	4
Contact hours	29	1
Practical activities	12	0