# STUDY MODULE DESCRIPTION FORM

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| Name of the module/subject<br>**Fluid Mechanics** | | Code<br>**1010134241010130197** |
| Field of study<br>**Environmental Engineering Extramural First-** | Profile of study (general academic, practical)<br>**(brak)** | Year /Semester<br>**2 / 4** |
| Elective path/specialty<br>**-** | Subject offered in:<br>**Polish** | Course (compulsory, elective)<br>**obligatory** |
| Cycle of study:<br>**First-cycle studies** | Form of study (full-time,part-time)<br>**part-time** | |
| No. of hours<br>Lecture: **12** Classes: **-** Laboratory: **12** Project/seminars: **-** | | No. of credits<br>**3** |
| Status of the course in the study program (Basic, major, other)<br>**(brak)** | (university-wide, from another field)<br>**(brak)** | |
| Education areas and fields of science and art<br>**technical sciences**<br>**Technical sciences** | | ECTS distribution (number and %)<br>**3 100%**<br>**3 100%** |

**Responsible for subject / lecturer:**

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**Responsible for subject / lecturer:**

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**Prerequisites in terms of knowledge, skills and social competencies:**

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|---|---|---|
| 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<br>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 student has a basic knowledge necessary for modeling the flow of water in the soil (achieved during lectures and laboratory exercises) - [[K_W03, K_W07]]
2. The student understands the causes of water hammer and cavitation phenomena in hydraulic systems, and knows the laws used to describe them (achieved during lectures) - [[K_W03, K_W07]]
3. The student knows and understands the phenomena occurring during the flow in open channels (free surface flow) and knows equations describing these phenomena (achieved during lectures and laboratory exercises) - [[K_W03, K_W07]]
4. The student knows and understand the laws describing liquid flows from the tanks (achieved during lectures) - [[K_W03, K_W04]]

**Skills:**

1. The student can calculate: hazard of cavitation in hydraulic systems, flow rates in free surface flows, optimal shapes of channels in free surface flows, discharge time of tanks and vessels (achieved during lectures and laboratory exercises) - [[K_U01, K_U013,]]

2. The student can measure: pressure of fluid (static, dynamic and total), average velocity of fluid in internal and free surface flows, pressure losses in pipes and fittings, power and efficiency of pumps, fans and blowers (achieved during lectures and laboratory exercises) - [[K_U01, K_U08, K_U09]]

## Social competencies:

1. The student understands the need for teamwork in solving theoretical and practical problems (achieved during lectures and laboratory exercises) - [[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 laboratory exercises) - [[K_K05]]

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

## Assessment methods of study outcomes

Lectures (results W03, W04, W07, U01, U08, U09, U13)

Two parts final written exam. Part 1: 2 problems to solve (60 min.); Part 2: 4 questions to answer (30 min.). List of questions is published at the beginning of the semester.

Continuous assessment during lectures (rewarding activity of the students).

To pass each of the two parts of the exam there is necessary to obtain at least 50% of the maximum points (max=20 points). The exam is passed if both part 1 and part 2 are passed. Corrected (Improved) is only this part which was failed.

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)

Laboratory exercises (recults U01, U08, U09, U13)

Assessment of individual prepared reports and their oral presentation

Continuous assessment of the students during laboratory exercises.

## Course description

Water hammer phenomenon. 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. Measurements of liquid flow in open channels. Underground water motion. Water inflow to traditional and artesian wells.

Teaching method:

Classical lecture with elements of conversation

Laboratory exercises ? teaching by experimentation.

## Basic bibliography:

1. Mitosek M., Mechanika płynów w inżynierii i ochronie środowiska. Warszawa, PWN 2014

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. Bogusławski L. (Red.), Ćwiczenia laboratoryjne z mechaniki płynów. Wydawnictwo Politechniki Poznańskiej, Poznań 1999

5. Niełacny M., Ćwiczenia laboratoryjne z mechaniki płynów. Wydawnictwo Politechniki Poznańskiej, Poznań 1996

## 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) |
|---|---|

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|---|---|
| 1. Participation in lectures (contact hours) | 12 |
| 2. Participation in laboratory exercises (contact hours, practical training) | 12 |
| 3. Preparation for the laboratory exercises (autonomus learning) | 12 |
| 4. Preparing (at home) reports of the laboratory exercises (autonomus learning) | 15 |
| 5. Participation in consultations related to the lectures and laboratory exercises (contact hours) | 3 |
| 6. Preparation for the exam and the presence at the exam (autonomus learning) | 21 |

**Student's workload**

| Source of workload | hours | ECTS |
|---|---|---|
| Total workload | 75 | 3 |
| Contact hours | 29 | 1 |
| Practical activities | 24 | 1 |