SYLLABUS OF A MODULE

Polish name of a module	**Mechanika płynów**
English name of a module	**Fluid mechanics**
ISCED classification - Code	*0710*
ISCED classification - Field of study	*Engineering & engineering trades*
Languages of instruction	*English*
Level of qualification:	*1*
Number of ECTS credit points	*6*
Examination:	*EW*
Available in semester:	*Y*

Number of hours per semester:

Lecture	Exercises	Laboratory	Seminar	E-learning	Project
30E	30	15	0	0	0

MODULE DESCRIPTION

MODULE OBJECTIVES

O1. Understanding the fundamental properties of fluids, properties of pressure as a scalar quantity, hydrostatic pressure and hydrostatic forces

O2. Understanding various methods of fluid motion description, understanding basic properties of fluid motion for ideal and viscous fluids

O3. Ability to use the one dimensional theory of fluid motion for ideal and viscous fluids to solve practical problems

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on the mathematical analysis and physics
2. Knowledge of the basic course of mechanics
3. Ability of individual work

LEARNING OUTCOMES

LO 1 - theoretical and practical knowledge in statics of fluid mechanics

LO 2 - theoretical and practical knowledge in kinematics and dynamics of perfect fluids

LO 3 - theoretical and practical knowledge in kinematics and dynamics of real fluids

MODULE CONTENT

Type of classes - lecture	**Number of hours**
Lec 1-4 - Basic concepts: solid body versus fluid mechanics, fluid as a continuum, basic physical properties of fluids, action of normal and shear forces upon the fluid element, viscosity as a physical property of fluids and the property of fluid motion.	**4**
Lec 5-6 - Equilibrium of steady fluid: equilibrium equation of steady fluid in a gravity field.	**2**
Lec 7-10 - Connected vessels principle: liquid manometers, atmospheric pressure, the reference level for pressure measurement, Pascal's law.	**4**
Lec 11-16 - Hydrostatic forces: hydrostatic forces acting on plane and curved surfaces, hydrostatic forces acting on immersed bodies, equilibrium of immersed and floating bodies.	**6**
Lec 17-20 - Description of fluid motion: Lagrange and Euler's description of fluid motion, fluid element trajectory and streamline, streamtube, continuity condition, Euler's and N–S equations and their solution methods.	**4**
Lec 21-23 - Bernoulli equation for ideal fluids: Bernoulli equation along the streamline for ideal fluid, measurement of flow velocity with pressure tubes.	**3**
Lec 24-25 - Momentum conservation principle, hydrodynamic forces.	**2**
Lec 26-27 - Bernoulli equation for viscous fluids: energy losses in a viscous fluid, major and minor losses, interpretation of energy transformations in the flow of viscous fluid.	**2**

Lec 28-30 - Flow of viscous fluid in a pipeline: flow in non-circular ducts, iterative calculation of flow losses, flows through long pipelines, finding the correct pipe diameter for a given fluid flux, flow through a pipeline network.	**3**
Sum	**30**
Type of classes - tutorial	**Number of hours**
T 1 - Basic physical properties of fluids	**2**
T 2-3 - Statics. Hydrostatic pressure, communicating vessels. Pascal's law	**4**
T 4-5 - Euler's law. Isopotential surfaces	**4**
T 6 - Hydrostatic forces on flat surfaces	**2**
T 7 - Hydrostatic forces on curved surfaces	**2**
T 8-9 - Flow kinematics	**4**
T 10-11 - Bernoulli equation for ideal fluids	**4**
T 12-13 - Momentum conservation principle	**4**
T 14-15 - Bernoulli equation for viscous fluids	**4**
sum	**30**
Type of classes - laboratory	**Number of hours**
Lab 1-2 - Measurements of flow velocity by pressure probes	**2**
Lab 3 - Verification of Boyle-Marriot law	**1**
Lab 4-5 - Osborne Reynolds experiment	**2**
Lab 6-7 - Free discharge from the tank	**2**
Lab 8-9 - Efficiency of an axisymmetric diffuser	**2**
Lab 10-11 - Measurement of jet forces	**2**
Lab 12-13 - Friction losses in a pipeline	**2**
Lab 14-15 - Energy losses in pipe fittings	**2**
sum	**15**

TEACHING TOOLS

1. Lecture with Power Point presentation, lecture notes, sample problems
2. Tutorials with Power Point presentation, tutorial book
3. Experimental rigs and measuring equipment
4. Laboratory tutorials

WAYS OF ASSESSMENT (F – FORMATIVE, S – SUMMATIVE)

F1 - assessment of preparation for laboratory exercises
F2 - assessment of the ability to apply the acquired knowledge while doing the exercises
F3 - evaluation of reports on the implementation of exercises covered by the curriculum
F4 - assessment of activity during classes
S1 - assessment of the ability to solve the problems posed and the manner of presentation obtained results - pass mark *
S2 - assessment of mastery of the teaching material being the subject of the lecture - exam

*) in order to receive a credit for the module, the student is obliged to attain a passing grade in all laboratory classes as well as in achievement tests.

STUDENT'S WORKLOAD

No	**Forms of activity**	**Average number of hours required for realization of activity**
1. Contact hours with teacher		
1.1	Lectures	30
1.2	Tutorials	30
1.3	Laboratory	15
1.4	Seminar	0
1.5	Project	0
1.6	Examination	3
	Total number of contact hours with teacher:	78

2. Student's individual work		
2.1	Preparation for tutorials and tests	20
2.2	Preparation for laboratory exercises, writing reports on laboratories	15
2.3	Preparation of project	0
2.4	Preparation for final lecture assessment	0
2.5	Preparation for examination	20
2.6	Individual study of literature	17
Total number of hours of student's individual work:		72
Overall student's workload:		150
Overall number of ECTS credits for the module		6
Number of ECTS points that student receives in classes requiring teacher's supervision:		3.12 ECTS
Number of **ECTS** credits acquired during practical classes including laboratory exercises and projects:		3.2 ECTS

BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

1. Drobniak S.: Fluid Mechanics - an Introduction. TEMPUS PROJECT, CzUT publication, 2002.
2. Shaughnessy E.J., Katz I.M., Schaffer J.P.: Introduction to Fluid Mechanics. Oxford University Press, 2005
3. White F.M.: Fluid Mechanics. McGraw-Hill, 2003
4. Evett J.B., Liu C., Fundamentals of Fluid Mechanics. McGraw-Hill, 1987
5. Durst F.: Fluid Mechanics. An introduction to the theory of fluid flows. Springer-Verlag, Berlin, 2008
6. Gunt - Manual: Fundamentals of fluid mechanics. Hamburg, 10/2021

MODULE COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

dr Dariusz Asendrych, dariusz.asendrych@pcz.pl