## **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	15	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**

	Number
Type of classes - lecture	of
	hours

viscosity as a physical property of fluids and the property of fluid motion.  Lec 5-6 - Equilibrium of steady fluid: equilibrium equation of steady fluid in gravity field.  Lec 7-10 - Connected vessels principle: liquid manometers, atmospheric pressure, reference level for pressure measurement, Pascal's law.  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.  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.  Lec 21-24 - Bernoulli equation for ideal fluids: Bernoulli equation along the streamline for ideal fluid, measurement of flow velocity with pressure tubes.  Lec 25-26 - Bernoulli equation for viscous fluids: energy losses in viscous fluid, major and minor losses, interpretation of energy transformations in flow of viscous fluid.  Lec 27-30 - Flow of viscous fluid in a pipeline: flow in a 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.  Sum 30  Number of classes - tutorial	Lab 5 - Determination of the volumetric-rate correction factor (Coriolis coefficient)  Lab 6 - Determination of axisymmetric diffuser efficiency  Lab 7 - Characteristics of the nozzle flow fed from the open tank  Lab 8 - Determination of a metacentric height for floating bodies  Lab 9 - Determination of hydrostatic force and its application point for arbitrarily oriented flat surfaces  Lab 10 - Verification of Stevin's theorem  Lab 11 - Determination of the critical Reynolds number for circular pipe flow  Lab 12-13 - Energy losses in the flow through a pipeline  Lab 14-15 - Measurement of flow velocity in a pipeline, determination of hydrostatic	1 1 1 1 1 2
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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,	

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#### **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
- 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
- ${\bf S1}$  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

#### 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	15
1.3	Laboratory	15
1.4	Seminar	0
1.5	Project	0
1.6	Examination	3
	Total number of contact hours with teacher:	63
2	. Student's individual work	
2.1	Preparation for tutorials and tests	30
2.2	Preparation for laboratory exercises, writing reports on laboratories	30
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	15
Total number of hours of student's individual work:		87
	Overall student's workload:	150
Overa	ll number of ECTS credits for the module	6
Number of ECTS points that student receives in classes requiring teacher's		2.52 ECTS

<sup>\*)</sup> 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.

supervision:	
Number of <b>ECTS</b> credits acquired during practical classes including laboratory exercises and projects:	2.4 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

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

dr Dariusz Asendrych, dariusz.asendrych@pcz.pl