MODULE DESCRIPTION

Module code	full-time studies:	**Z-ZIP1-E-305**
	part-time studies:	**Z-ZIPN1-E-305**
Module name	**Fluid Mechanics and Heat Transfer**	
Module name in Polish	**Mechanika Płynów i Wymiana Ciepła**	
Valid from academic year	**2019/2020**	

MODULE PLACEMENT IN THE SYLLABUS

Field of study	**MANAGEMENT AND PRODUCTION ENGINEERING**
Level of education	**1st degree**
Studies profile	**General**
Form and method of conducting classes	**Full-time and Part-time**
Specialisation	**All**
Unit conducting the module	**Department of Production Engineering**
Module co-ordinator	**Artur Bartosik, PhD, DSc**
Approved by:	**Dariusz Bojczuk, PhD, DSc**

MODULE OVERVIEW

Type of subject / group of subjects	**Major**
Module status	**Compulsory**
Language of conducting classes	**English**
Module placement in the syllabus - semester	**Semester III**
Initial requirements	**No requirements**
Examination (YES/NO)	**YES**
Number of ECTS credit points	**4**

Method of conducting classes		**Lecture**	**Classes**	**Laboratory**	**Project**	**Other**
Per semester	full-time studies:	**30**	**15**			
	part-time studies:	**18**	**9**			

TEACHING RESULTS AND THE METHODS OF ASSESSING TEACHING RESULTS

Category	Symbol	Learning outcomes	Assignations to the directional learning outcomes
Knowledge	W01	A student has knowledge about the physical properties of fluids, the type of fluid motion, heat transfer and the basic equations of fluid mechanics and heat transfer.	ZIP1_W02
	W02	A student is familiar with measurements devices including the calibration technics and knows principles of measurements in fluid flow.	ZIP1_W08
Skills	U01	A student can obtain data from the literature and other sources regarding the physical properties of fluids, flow and thermal properties.	ZIP1_U01
	U02	A student can use equations of fluid mechanics and heat transfer to calculate fluid flow rate, friction losses in flowing fluid and thermal resistance.	ZIP1_U14
	U03	A student can perform a simple analysis of the type of fluid motion and heat flow using proper equations.	ZIP1_U17
Social competences	K01	A student understands needs of lifelong learning in order to improve skills in fluid mechanics and heat transfer.	ZIP1_K01
	K02	A student is ready to work as a team member in order to solve engineering problems relevant to fluid mechanics and heat transfer.	ZIP1_K04

TEACHING CONTENTS

Method of conducting classes	Teaching contents
Lecture	1. Structure of fluid mechanics; physical properties. 2. Newtonian hypothesis, Newtonian and non-Newtonian fluids. 3. Types of pressure and instruments to its measurements. 4. Pressure and temperature distribution in Earth atmosphere. 5. Hydrostatics – equilibrium equation for liquids. Hydrostatic thrust on flat plat and swimming of body. 6. Laminar and turbulent flow; Reynolds experiment 7. Continuity equation; Bernoullie equation for ideal fluids. 8. Bernoullie equation for real fluid; Darcy-Weisbach equation, Friction factor - Nikuradse graph. 9. Basic concepts of heat transfer. Characteristics of the heat transfer phenomenon: conduction, convection, radiation. 10. Conduction – Fourier law; Heat transfer coefficient and its experimental set up. 11. Conduction in rectangular and cylindrical geometry – one and several layers. 12. Convection – Newtonian equation; heat transfer coefficient and its set up; convection and conduction through rectangular and cylindrical geometry; methods of enhancing and depressing the heat transfer. 13. Radiation – radiation phenomena; emission and absorption coefficient; Stefana-Boltzmanna and Kirchhoffa law. 14. Methods of heat production.

Classes	1. Physical properties of fluids. 2. Application of equilibrium equation to measurements and calculations of pressure. 3. Application of continuity and Bernoulliego equations in ideal flows. 4. Application of continuity and Bernoulliego equations in real flows; Darcy-Weisbach equation - calculation of pipeline characteristics. 5. Application of the heat conduction equation in a flat and cylindrical barrier for single- and multi-layer cases. 6. Application of the equation of heat conduction and convection for calculations in complex heat exchange cases.

METODS OF ASSESSING TEACHING RESULTS

Symbol	Methods of checking the learning outcomes *(select X)*					
	Oral exam	Written exam	Test	Project	Statement	Other
W01		X	X			
W02		X	X			
U01			X			
U02		X	X			
U03		X	X			
K01			X			
K02			X			

FORM AND CONDITIONS OF PASSING

Form of classes	Form of credit	Passing conditions
Lecture	Exam	Obtaining a min. 50% correct answers based on the test with closed and open questions.
Classes	Credit with grade	Obtaining a min. 50% from accounting tasks.

STUDENT WORKLOAD

<table>
<tr><th colspan="13">Balance of ECTS points</th></tr>
<tr><th rowspan="3">No.</th><th rowspan="3">Type of student's activity</th><th colspan="10">Student's workload</th><th rowspan="3">Unit</th></tr>
<tr><th colspan="5">full-time</th><th colspan="5">part-time</th></tr>
<tr><th>Lc</th><th>C</th><th>Lb</th><th>P</th><th>O</th><th>Lc</th><th>C</th><th>Lb</th><th>P</th><th>O</th></tr>
<tr><td>1.</td><td>Participation in the activities</td><td>30</td><td>15</td><td></td><td></td><td></td><td>18</td><td>9</td><td></td><td></td><td></td><td>h</td></tr>
<tr><td>2.</td><td>Other (consultation, exam)</td><td>4</td><td>2</td><td></td><td></td><td></td><td>4</td><td>2</td><td></td><td></td><td></td><td>h</td></tr>
<tr><td>3.</td><td>Number of hours of a student's assisted work</td><td colspan="5">51</td><td colspan="5">33</td><td>h</td></tr>
<tr><td>4.</td><td>Number of ECTS credit points which are allocated for assisted work</td><td colspan="5">2,0</td><td colspan="5">1,3</td><td>ECTS</td></tr>
<tr><td>5.</td><td>Number of hours of a student's unassisted work</td><td colspan="5">49</td><td colspan="5">67</td><td>h</td></tr>
<tr><td>6.</td><td>Number of ECTS credit points which a student receives for unassisted work</td><td colspan="5">2,0</td><td colspan="5">2,7</td><td>ECTS</td></tr>
<tr><td>7.</td><td>Work input connected with practical classes</td><td colspan="5">33</td><td colspan="5">33</td><td>h</td></tr>
<tr><td>8.</td><td>Number of ECTS credit points which a student receives for practical classes</td><td colspan="5">1,3</td><td colspan="5">1,3</td><td>ECTS</td></tr>
<tr><td>9.</td><td>Total number of hours of a student's work</td><td colspan="5">100</td><td colspan="5">100</td><td>h</td></tr>
<tr><td>10.</td><td>Punkty ECTS za moduł
1 ECTS=25 hours</td><td colspan="10">4</td><td>ECTS</td></tr>
</table>

LITERATURE

1. Gerhart A.L., Gerhart P.M., Hochstein J.I. (2021), *Fundamentals of Fluid Mechanics*, 9th Edition, Munson, Young and Okiishi's.
2. Kirkup L. (1996), *Experimental Methods: An Introduction to the Analysis and Presentation of Data*, pp. 216. ISBN 0-471-33579-7. Wiley-VCH.
3. Nakayama Y., Boucher R.F. (2002), *Introduction to Fluid Mechanics*, Butterworth-Heinemann.
4. Russeli G. (2020), *Fluid Mechanics in SI Units*, Editor: Pearson, EAN 9781292247304.