MODULE DESCRIPTION

Module code	**Z-ZIP-1006**
Module name	**Mechanika Płynów i Wymiana Ciepła**
Module name in English	**Fluid Mechanics and Heat Transfer**
Valid from academic year	**2016/2017**

A. MODULE PLACEMENT IN THE SYLLABUS

Subject	**Management and Production Engineering**
Level of education	**1st degree** *(1st degree / 2nd degree)*
Studies profile	**General** *(general / practical)*
Form and method of conducting classes	**Full-time** *(full-time / part-time)*
Specialisation	**All**
Unit conducting the module	**The Department of Production Engineering**
Module co-ordinator	**Artur Bartosik, PhD hab., Eng., Professor of the University**
Approved by:	

B. MODULE OVERVIEW

Type of subject/group of subjects	**Major** *(basic / major / specialist subject / conjoint / other HES)*
Module status	**Compulsory** *(compulsory / non-compulsory)*
Language of conducting classes	**English**
Module placement in the syllabus - semester	**3rd semester**
Subject realisation in the academic year	**Winter semester** *(winter / summer)*
Initial requirements	**No requirements** *(module codes / module names)*
Examination	**Yes** *(yes / no)*
Number of ECTS credit points	**4**

Method of conducting classes	Lecture	Classes	Laboratory	Project	Other
Per semester	**30**	**15**			

C. TEACHING RESULTS AND THE METHODS OF ASSESSING TEACHING RESULTS

Module target	The aim of the module is to acquire theoretical knowledge and practical skills of solving basic application issues as regards hydrostatics, the kinematics of non-adhesive fluids, and the hydrodynamics of adhesive fluid. Another aim is to learn the phenomenon of heat transfer together with its mathematical description as well as to acquire the ability to solve basic technological issues based on the laws of heat transfer, in particular taking the following into consideration: - the analysis of the "type of heat transfer" - calculations of the states of heat transfer

Effect symbol	Teaching results	Teaching methods *(l/c/lab/p/other)*	Reference to subject effects	Reference to effects of a field of study
W_01	Knowledge on physical properties of Newtonian and non-Newtonian fluids, and its measurements Knowledge on practical meaning of buoyancy and thrust.	l	K_W02	T1A_W01 T1A_W02 T1A_W07
W_02	Basic knowledge on fluid motion phenomena and governing equations in fluid mechanics. Facilitating pump–pipeline transportation.	l/c	K_W02 K_W06	T1A_W01 T1A_W02 T1A_W07 T1A_W04
W_03	Basic knowledge on phenomena of heat transfer and their governing equations.	l	K_W02	T1A_W01 T1A_W02 T1A_W07
U_01	A student knows place and role of fluid mechanics in technics and has ability to use equilibrium equation of liquids and to calculate simple thrusts.	l/c	K_U01 K_U17	TA1_U01 TA1_U09 TA1_U16
U_02	A student has ability to use fluid mechanics equations in order to calculate flow rate and friction in any flow field. Students knows how to calculate pipeline characteristics and find best pipeline-machine efficiency.	l/c	K_U01 K_U03 K_U06 K_U17	TA1_U01 TA1_U03 TA1_U06 TA1_U09 TA1_U16
U_03	A student has ability to predict simple heat exchange processes.	l/c	K_U01 K_U06 K_U17	TA1_U01 TA1_U06 TA1_U09 TA1_U16
K_01	A student understand needs of lifelong learning in order to improve skills in fluid mechanics and heat transfer.	l/c	K_K01	T1A_K01
K_02	A student has ability to work as a team member in order to solve engineering problems relevant to fluid mechanics and heat transfer.	l/c	K_K04	T1A_K03 T1A_K04

Teaching contents:

1. Teaching contents as regards lectures

Lecture number	Teaching contents	Reference to teaching results for a module
1	Structure of fluid mechanics; physical properties.	W_01 U_01 K_01
2	Newtonian hypothesis, Newtonian and non-Newtonian fluids.	W_01 U_01 K_01
3	Types of pressure and instruments to its measurements.	W_01

		U_01 K_01
4	Pressure and temperature distribution in Earth atmosphere.	W_01 U_01 K_01
5	Hydrostatics – equilibrium equation for liquids Hydrostatic thrust on flat plat and swimming of body	W_01 U_01 K_01
6	Laminar and turbulent flow; Reynolds experiment	W_02 U_02 K_01
7	Continuity equation; Bernoullie equation for ideal fluids	W_02 U_02 K_01
8	Bernoullie equation for real fluid; Darcy-Weisbach equation, Friction factor - Nikuradse graph	W_02 U_02 K_01
9	Pipeline characteristics; Flowing machine characteristics and matching point of both characteristics	W_02 U_02 K_01 K_02
10	Heat transfer phenomena - conduction, convection and radiation	W_03 U_03 K_01
11	Conduction – Fourier law; Heat transfer coefficient and its experimental set up.	W_03 U_03 K_01
12	Conduction in rectangular and cylindrical geometry – one and several layers	W_03 U_03 K_01
13	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	W_03 U_03 K_01
14	Radiation – radiation phenomena; emission and absorption coefficient; Stefana-Boltzmanna and Kirchhoffa law	W_03 U_03 K_01
15	Heat exchangers; fuels; Methods of heat production	W_03 U_03 K_01

2. Teaching contents as regards classes

Class number	**Teaching contents**	**Reference to teaching results for a module**
1	Physical properties of fluids.	W_01 U_01 K_01
2	Application of equilibrium equation to measurements and calculations of pressure.	W_01 U_01 K_01
3	Application of continuity and Bernoulliego equations in ideal flows.	W_02 U_02 K_01
4	Application of continuity and Bernoulliego equations in real flows; Darcy-Weisbach equation - calculation of pipeline characteristics.	W_02 U_02 K_01 K_02

5	Application of heat transfer equation in simple geometry.	W_03 U_03 K_01
6	Application of conduction and convection in engineering.	W_03 U_03 K_01
7	Application of conduction, convection and radiation in engineering.	W_03 U_03 K_01

3. Teaching contents as regards laboratory classes

Laboratory class number	Teaching contents	Reference to teaching results for a module

4. The characteristics of project assignments

The methods of assessing teaching results

Effect symbol	Methods of assessing teaching results *(assessment method, including skills – reference to a particular project, laboratory assignments, etc.)*
W_01	**A final test and a written examination** Student who wants to obtain good mark should know: fluid properties and technics of measurements; buoyancy and thrust equations. Student who wants to obtain very good mark should know additionally how to analyse crucial factors affecting buoyancy and thrust and understand methodology of measurements of flow properties.
W_02	**A final test and a written examination** Student who wants to obtain good mark should know: flow phenomena, methodology of pipeline characteristics calculation. Student who wants to obtain very good mark should know additionally crucial factors affecting flow structure and pipeline characteristics.
W_03	**A final test and a written examination** Student who wants to obtain good mark should has basic knowledge on heat transfer process and governing equations. Student who wants to obtain very good mark should know additionally how to use proper equation for heat transfer in complex geometry.
U_01	**A final test and a written examination** Student who wants to obtain good mark should has basic knowledge gained during lectures and exercises on applied fluid mechanics, which includes equilibrium equation, thrust. Student who wants to obtain very good mark should has a skills in interpreting of flow phenomena in reference to choosing proper equations.
U_02	**A final test and a written examination** Student who wants to obtain good mark should has basic knowledge gained during lectures and exercises in order to calculate flow rate, flow friction, pipeline characteristics, and match flow machine and pipeline characteristics. Student who wants to obtain very good mark should has a skills in selecting crucial parameters in order to obtain required friction and flow rate.
U_03	**A final test and a written examination** Student who wants to obtain good mark should has basic knowledge gained during lectures

	and exercises in order to predict heat transfer process in simple geometry. Student who wants to obtain very good mark should has a skills in analysing heat transfer in complex geometry.
K_01	**Observation of student's attitudes during lectures and classes, a discussion during lectures and classes** Student who wants to obtain good mark should understand needs of lifelong learning in fluid mechanics and heat transfer. Student who wants to obtain very good mark should be active during lectures and has leadership attitudes.
K_02	**Observation of student's attitudes during lectures and classes, a discussion during lectures and classes** Student who wants to obtain good mark should has ability in team working in order to solve engineering problems. Student who wants to obtain very good mark should be active during lectures and has leadership attitudes.

D. STUDENT'S INPUT

ECTS credit points		
	Type of student's activity	**Student's workload**
1	Participation in lectures	**30**
2	Participation in classes	**15**
3	Participation in laboratories	
4	Participation in tutorials (2-3 times per semester)	**3**
5	Participation in project classes	
6	Project tutorials	
7	Participation in an examination	**2**
8		**50**
9	**Number of hours requiring a lecturer's assistance**	**2** *(sum)*
10	**Number of ECTS credit points which are allocated for assisted work** *(1 ECTS point=25-30 hours)*	**15**
11	Unassisted study of lecture subjects	**10**
12	Unassisted preparation for classes	**5**
13	Unassisted preparation for tests	
14	Unassisted preparation for laboratories	
15	Preparing reports	
15	Preparing for a final laboratory test	
17	Preparing a project or documentation	
18	Preparing for an examination	**20**
19		
20	**Number of hours of a student's unassisted work**	**50** *(sum)*
21	**Number of ECTS credit points which a student receives for unassisted work** *(1 ECTS point=25-30 hours)*	**2**
22	**Total number of hours of a student's work**	**100**
23	**ECTS points per module** *1 ECTS point=25-30 hours*	**4**
24	**Work input connected with practical classes** *Total number of hours connected with practical classes*	**50**
25	**Number of ECTS credit points which a student receives for practical classes** (1 ECTS point=25-30 hours)	**2**

E. LITERATURE

Literature list	1. Bartosik A., *Fluid Mechanics*, No. 149, Kielce University of Technology, Kielce 2005. 2. Bartosik A., *Laboratory in Fluid Mechanics*, No. 368, Kielce University of Technology, Kielce 2001.
Module website	