COURSE DESCRIPTION CARD – Thermal and Flow Processes

<table>
<tr><td colspan="10">Faculty of Mechanical Engineering</td></tr>
<tr><td>Field of study</td><td colspan="7"></td><td>Degree level and programme type</td><td>Bachelor's degree</td></tr>
<tr><td>Specialization/ diploma path</td><td colspan="7"></td><td>Study profile</td><td></td></tr>
<tr><td rowspan="2">Course name</td><td colspan="7" rowspan="2">Thermal and Flow Processes</td><td>Course code</td><td>IS-FME-00281S</td></tr>
<tr><td>Course type</td><td></td></tr>
<tr><td rowspan="2">Forms and number of hours of tuition</td><td>L</td><td>C</td><td>LC</td><td>P</td><td>SW</td><td>FW</td><td>S</td><td>Semester</td><td>winter / summer</td></tr>
<tr><td>30</td><td>15</td><td>15</td><td></td><td></td><td></td><td></td><td>No. of ECTS credits</td><td>6</td></tr>
<tr><td>Entry requirements</td><td colspan="9">Mathematics II</td></tr>
<tr><td>Course objectives</td><td colspan="9">Getting students acquainted with: The conceptual formalism used in thermodynamics, fluid mechanics and heat transfer, necessary for the analysis of thermal and flow phenomena; Basic models describing fluid flow, energy conversion processes and heat transfer processes - in the scope enabling the performance of basic quantitative and qualitative analyses in mechatronics; The equipment used in measurements and the measurement methodology; The analysis methods of basic physical quantities characterising thermal and flow processes.</td></tr>
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Course content	**Lecture: Basic concepts concerning the classification of physical quantities; the concept of system and control volume, the basics of balancing extensive quantities. Properties of liquids and gases. The First Law of Thermodynamics. Thermodynamic processes and simple gas cycles. The Second Law of Thermodynamics. Power cycles and heat pump cycles. Properties of liquids and gases. Models of fluids and flows. Elements of statics, kinematics and fluid dynamics. Basic equations of fluid mechanics. The similarity of transport phenomena. Perfect and viscous fluid flow analysis. Elementary problems of gas dynamics. Basic mechanisms of heat transfer: heat conduction, free and forced convection, and thermal radiation. Heat transfer with phase change processes. Fundamentals of: heat exchangers theory, basic flow systems and calculation methods for thermal and flow variables of heat exchangers.** **Classes: Practical usage of methods, techniques and software for solving calculation problems concerning the material realized during the lectures.** **Laboratory classes: Characteristics of basic functional devices in thermal and flow systems. Selected issues of controlling the operation of heat and flow systems. Measurements of basic parameters, temperature, pressure, velocity and flow rate, describing thermal and flow processes. Metrological analysis of the obtained results. Basics of building data measurement, recording and acquisition systems.**

Teaching methods	**Information and problematic lecture; classes; laboratory exercises**	
Assessment method	**lecture – two tests** **classes – a written test** **laboratory classes – pre-lab tests, lab reports evaluation, activity in the classroom**	
Symbol of learning outcome	**Learning outcomes**	**Reference to the learning outcomes for the field of study**
LO1	**Student defines the basic concepts and discusses with understanding the basic laws of thermal-flow processes**	
LO2	**Student formulates basic equations describing the phenomena related to fluid flow and heat transfer and uses them to solve the practical problems**	
LO3	**Student can discuss and determine the basic parameters describing the functioning of thermal-flow systems**	

LO4	Student correctly develops and analyses the results of measurements, analyses and evaluates the operation of selected devices and thermal-flow systems.	
Symbol of learning outcome	Methods of assessing the learning outcomes	Type of tuition during which the outcome is assessed
LO1	written tests	L
LO2	written tests	L, C
LO3	pre-lab tests, lab reports evaluation, activity in the classroom	LC
LO4	lab reports evaluation, activity in the classroom	LC

Student workload (in hours)		No. of hours
Calculation	lecture attendance	30
	preparation to pass the lecture	30
	participation in classes and laboratory classes	30
	preparation to pass the classes	25
	preparation to pass the laboratory classes	30
	participation in student-teacher sessions	5
	TOTAL:	150

Quantitative indicators	HOURS	No. of ECTS credits
Student workload – activities that require direct teacher participation	65	2,6
Student workload – practical activities	85	3,4

Basic references	1. Çengel Y.A., Cimbala J.M.: Fluid mechanics: fundamentals and applications, McGraw-Hill Education, Singapore 2014. 2. Munson B. R. [et al.]: Fundamentals of fluid mechanics: international student version, Wiley, New York 2009.
	3. Çengel Y., Heat and Mass Transfer, McGraw-Hill Education - Europe, 2014 4. Çengel Y.A., Boles M.A., Thermodynamics. An Engineering Approach, McGraw-Hill Book, 2015. 5. Moran, M., Shapiro H.N., Fundamentals of engineering thermodynamics SI version, Wiley J., 2006.
Supplementary references	1. Fox R, Pritchard P., McDonald A., Introduction to fluid mechanics, Hoboken: John Wiley a. Sons, 2010 2. Nellis G., Klein S.A., Heat transfer, Cambridge University Press, 2009. 3. Myer Kutz Ed., Heat-transfer calculations, New York : McGraw-

	Hill, 2006.	
Organisational unit conducting the course	Department of Thermal Engineering	Date of issuing the programme
Author of the programme	Wojciech Angielczyk	2025-02-07

L – lecture, C – classes, LC – laboratory classes, P – project, SW – specialization workshop, FW - field work, S – seminar