COURSE SPECIFICATION

Course code	full-time programme:	**M#2-S1-ME-706**
	part-time programme:	
Course title in Polish	**Maszyny cieplno-przepływowe**	
Course title in English	**Fluid machinery and heat exchangers**	
Valid from (academic year)	**2024/2025**	

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**first-cycle**
Type of education	**academic**
Mode of study	**full-time programme**
Specialism	**all**
Department responsible	**Department of Mechanics and Heat Transfer**
Course leader	**dr hab. Robert Pastuszko, prof. PŚk**
Approved by	**dr hab. Jakub Takosoglu, prof. PŚk, Dean of the Faculty of Mechatronics and Mechanical Engineering**

COURSE OVERVIEW

Course type		**programme-specific**
Course status		**compulsory**
Language of instruction		**English**
Semester of delivery	full-time programme	**Semester VII**
	part-time programme	
Pre-requisites		
Examination required (YES/NO)		**NO**
ECTS value		**2**

Mode of instruction		**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	full-time programme	**15**	**15**			
	part-time programme					

LEARNING OUTCOMES

Category of outcome	**Outcome code**	**Course learning outcomes**	**Corresponding programme outcome code**
Knowledge	W01	On completion of the course, students will have an elementary knowledge of the types of fluid machinery and a basic knowledge of the construction of pumps and their parameters.	MiBM1_W02 MiBM1_W16

	W02	Students will have elementary knowledge of pump characteristics, liquid flow in a centrifugal pump, connection of pumps and their cooperation with a pipe system.	MiBM1_W02 MiBM1_W16
	W03	Students will have knowledge of the types, characteristics, and selection of fans for the ventilation system.	MiBM1_W02 MiBM1_W16
	W04	Students will have elementary knowledge of heat exchangers, renewable sources of energy, solar collectors, and heat pumps.	MiBM1_W02 MiBM1_W16
Skills	U01	On completion of the course, students will be able to determine the basic parameters of the pump, and use the pump characteristics. Students will have the skills to determine the operating point.	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U02	Students will have the skills to use the fan characteristics, and determine the fan/system operating point.	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U03	Students will be able to determine the heat transfer surface of a simple counter-flow or cross-flow exchanger.	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U04	Students can select a heat pump for the heating installation	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
Competence	K01	On completion of the course, students will be aware of the environmental impact of reducing energy consumption to drive pumps and fans, and the use of unconventional energy sources.	MiBM1_K02 MiBM1_K03 MiBM1_K06
	K02	Students are aware of the need to follow the rules of teamwork.	MiBM1_K02 MiBM1_K03 MiBM1_K06

COURSE CONTENT

Type of instruction lecture	Topics covered
lecture	General information, classification of fluid machinery. Reciprocating pumps and velocity pumps. Main categories of dynamic pumps. Pump capacity, useful pump head, power and efficiency. Pump performance curves and system curve. Operation point. Pump specific speed. Elementary analysis of the velocity vectors on the impeller blade. Liquid flow in a centrifugal pump - Euler turbomachine equation. Cooperation of pumps with the pipeline system - operating point. Pumps in series and parallel. Fans and blowers - division, characteristics, cooperation with the ventilation system. Operating point of a fan and system. Heat exchangers: recuperators and regenerators - types, construction, logarithmic temperature difference, overall heat transfer coefficients. Methods of using unconventional energy sources. Solar panels. Heat pumps.

class	Sample calculations of the basic operating parameters and construction dimensions of a centrifugal pump, determination of the power of the motor driving the pump. Cooperation of the pump with the system, pump and pumping system characteristics, determination of the operating point. Preliminary design of a centrifugal pump. Calculations of the basic parameters of fans and blowers. Determination of the pressure drop in the ventilation system. Determination of the air flow rate and the required outlet pressure and fan shaft power. Calculation of the overall heat transfer coefficients and heat transfer area for the heat exchanger. Selection of a heat pump.

ASSESSMENT METHODS

Outcome code	Methods of assessment *(Mark with an X where applicable)*					
	Oral examination	Written examination	Test	Project	Report	Other
W01			x			
W02			x			
W03			x			
W04			x			
U01			x			
U02			x			
U03			x			
U04			x			
K01						x
K02						x

ASSESSMENT TYPE AND CRITERIA

Mode of instruction	Assessment type	Assessment criteria
lecture	non-examination assessment	The pass mark is a minimum of 50% for the final in-class test.
class	non-examination assessment	The pass mark is a minimum of 50% for all the in-class tests.

OVERALL STUDENT WORKLOAD

ECTS weighting												
No.	Activity type	Student workload										Unit
		full-time programme					part-time programme					
		L	C	Lb	P	S	L	C	Lb	P	S	
1.	Scheduled contact hours	15	15									h
2.	Other contact hours (office hours, examination)	2	2									h
3.	**Total number of contact hours**	**34**										h
4.	**Number of ECTS credits for contact hours**	**1,4**										ECTS
5.	**Number of independent study hours**	**16**										h

6.	**Number of ECTS credits for independent study hours**	**0,6**		ECTS
7.	**Number of practical hours**	**25**		h
8.	**Number of ECTS credits for practical hours**	**1,0**		ECTS
9.	**Total study time**	**50**		h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**2**		ECTS

READING LIST

1. Y.A. Cengel, Y.M. Cimbala, Fluid Mechanics. Fundamentals and applications, McGraw-Hill, 2014
2. J. Chaurette, Pump system analysis and sizing, Fluid Design Inc., 2003
3. C. E. Brennen, Hydrodynamics of Pumps, Concepts ETI, Inc. and Oxford University Press, 1994
4. Basic Principles for the Design of Centrifugal Pump Installations, Sterling Fluid Systems Group, 2003
5. B. Nesbit, Handbook of Pumps and Pumping: Pumping Manual International, Elsevier Science & Technology Books, 2006
6. F. Bleier, Fan Handbook: Selection, Application, and Design, McGraw-Hill Education, 1998
7. Y.A. Cengel, *Heat Transfer – A Practical Approach*, McGraw Hill, 2003