Kielce University of Technology

FACULTY OF MECHATRONICS AND MECHANICAL ENGINEERING

Annex 9
to the Rector's Ordinance No. 35/19
of 12 June 2019

COURSE SPECIFICATION

Course code	**M#1- S1-ME-709**
Course title in Polish	**Maszyny Cieplno - Przepływowe**
Course title in English	**Fluid-Flow Machines and Heat Exchangers**
Valid from (academic year)	**2019/2020**

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**1st degree**
Type of education	**academic**
Mode of study	**full-time**
Specialism	**all**
Department responsible	**Department of Mechanics**
Course leader	**Dr hab inż. Robert Pastuszko, prof. PŚk**
Approved by	

COURSE OVERVIEW

Course type	**basic**
Course status	**compulsory**
Language of instruction	English
Semester of delivery	**semester 7**
Pre-requisites	**Fluid Mechanics, Thermodynamics**
Examination required (YES/NO)	NO
ECTS value	**2**

Mode of instruction	**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	**15**	**15**			

LEARNING OUTCOMES

Category of outcome	Outcome code	Course learning outcomes	Corresponding programme outcome code
Knowledge	W01	On completion of the course, students will have elementary knowledge of the types of fluid-flow machines, a basic knowledge of the construction of pumps and their parameters.	MiBM1_W04 MiBM1_W21
	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_W04 MiBM1_W21
	W03	Students will have knowledge of the types, characteristics and selection of fans for the ventilation system.	MiBM1_W04 MiBM1_W21
	W04	Students will have elementary knowledge of heat exchangers, renewable sources of energy, solar collectors, heat pumps.	MiBM1_W04 MiBM1_W21
Skills	U01	On completion of the course, students will be able to determine the basic parameters of the pump, 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, 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
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_K01 MiBM1_K02 MiBM1_K03
	K02	Students will understand the need for working in a group while performing calculations, follows the rules of teamwork.	MiBM1_K01 MiBM1_K02 MiBM1_K03 MiBM1_K04

COURSE CONTENT

Type of instruction*	Topics covered
lecture	General information, classification of fluid flow machines. 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, determining the power of the motor driving the pump
	Cooperation of the pump with the system, pump and the pumping system character-istics, determination of the operating point. Preliminary design of a centrifugal pump.
	Calculations of basic parameters of fans and blowers. Determination of the pressure drop in the ventilation system.
	Determination of air flow rate and required outlet pressure and shaft power of the fan.
	Calculation of the overall heat transfer coefficients and heat transfer area for the heat exchanger.

*) Please delete rows in the table above that are not applicable.

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			
K01						X
K02						X

ASSESSMENT TYPE AND CRITERIA

Mode of instruction*	Assessment type	Assessment criteria
lecture	non-examination assessment	The assessment in the form of an open-ended question test. The overall mark for the course is dependent on the number of points obtained for the coursework assignments. The pass mark is a minimum of 51 points. The highest mark 'very good' is awarded for 90-100 points.
class	non-examination assessment	The pass mark is a minimum of 50% for all the in-class tests.

*) Please delete rows in the table above that are not applicable.

OVERALL STUDENT WORKLOAD

ECTS weighting								
	Activity type	Student workload					Unit
1.	Scheduled contact hours	L	C	Lab	P	S	h
		15	15				
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, J. M. Cimbala, Fluid Mechanics. Fundamentals and Applications, McGraw-Hill Inc. 2014.
2. C. E. Brennen, Hydrodynamics of Pumps, Concepts ETI, Inc. and Oxford University Press, 1994
3. Basic Principles for the Design of Centrifugal Pump Installations, Sterling Fluid Systems Group, 2003
4. B. Nesbit, Handbook of Pumps and Pumping: Pumping Manual International, Elsevier Science & Technology Books, 2006
5. F. Bleier, Fan Handbook: Selection, Application, and Design, McGraw-Hill Education, 1998
6. Bayazitoglu, Y. Ozisik, Necati M.: Elements of Heat Transfer, McGraw-Hill Book Company, New York, 1988