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-706**
Course title in Polish	**Termodynamika II**
Course title in English	**Thermodynamics II**
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	**Mathematics and Physics**
Examination required (YES/NO)	YES
ECTS value	**3**

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

LEARNING OUTCOMES

Category of outcome	Out-come code	Course learning outcomes	Corresponding programme outcome code
Knowledge	W01	On completion of the course, students will have knowledge of the application of the second law of ther-modynamics to energy conversion systems.	MiBM1_W04 MiBM1_W21
	W02	Students will have knowledge of the properties of gas mixtures, humid air and its transformations.	MiBM1_W04 MiBM1_W21
	W03	Students will have fundamental knowledge about heat engines and refrigeration cycles, and the formulas ex-pressing their efficiency.	MiBM1_W04 MiBM1_W21
	W04	Students will have basic knowledge of the combustion of solid, liquid and gaseous fuels.	MiBM1_W04 MiBM1_W21
	W06	Students will have basic knowledge of heat transfer.	MiBM1_W04 MiBM1_W21
Skills	U01	On completion of the course, students will have the skills to use procedures for energy balancing and methods of energy transport between systems.	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U02	Students will be able to use mathematical tools to solve problems relating to the laws of thermodynamics.	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U03	Students will have basic skills related to operating an infrared camera	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U04	Students will be able to determine parameters of the humid air.	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
Competence	K01	On completion of the course, students will be aware of the impact on the natural environment of the way energy is generated and the operation of energy generating devices (heat engines, etc.)	MiBM1_K01 MiBM1_K02 MiBM1_K03
	K02	Students will know how to work in a group, follows the rules of teamwork; they will present and defend his posi-tion using factual arguments in a discussion.	MiBM1_K01 MiBM1_K02 MiBM1_K03 MiBM1_K04

COURSE CONTENT

Type of instruction*	Topics covered
lecture	Application of the second law of thermodynamics to energy conversion systems. Thermal efficiency of heat engines, coefficient of performance of heat pumps and energy efficiency rating of refrigerators and air conditioners.
	Examples of gas power cycles. Compressors. Heat pipes. Refrigeration cycles and refrigerators. Heat pumps. Unconventional sources of energy.
	Gas mixtures. Van der Waals equation. The Clapeyron equation and the Maxwell relations.
	Dry and atmospheric air. Specific and relative humidity. Mollier diagram. Examples of air conditioning processes.

	Basic information on heat transfer (conduction, convection, radiation, overall heat transfer), thermal resistance concept.
	Basic information about fuels and combusions.
laboratory	Determination of the temperature field by the thermal imaging method.
	Heat pipe operation.
	Boyle - Mariotte law (isothermal process).
	Determination of heat transfer rate and enthalpy changes for a control volume system
	Determination of fan characteristics.
	Measurements of the air – water-vapor mixture properties.

*) 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				
W05		X				
W06		X				
U01		X			X	
U02		X			X	
U03		X			X	
U04		X			X	
K01						X
K02						X

ASSESSMENT TYPE AND CRITERIA

Mode of instruction*	Assessment type	Assessment criteria
lecture	**examination assess-ment**	Examination 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.
laboratory	non-examination assessment	The pass mark is a minimum of *50%* for all the in-class tests and the post-lab reports

*) 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)	4		2			h
3.	**Total number of contact hours**	**36**					h

4.	**Number of ECTS credits for contact hours**	**1,4**	ECTS
5.	**Number of independent study hours**	**39**	h
6.	**Number of ECTS credits for independent study hours**	**1,6**	ECTS
7.	**Number of practical hours**	**38**	h
8.	**Number of ECTS credits for practical hours**	**1,5**	ECTS
9.	**Total study time**	**75**	h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**3**	ECTS

READING LIST

1. Yunis A. Cengel, Michael A. Boles: Thermodynamics: An Engineering Approach, eighth edition New York : McGraw-Hill Publishing Company, 2015
2. Howell, John R. : Fundamentals of engineering thermodynamics, New York McGraw-Hill Book Company, cop. 1987
3. Michael J. Moran, Howard N. Shapiro : Fundamentals of engineering thermodynamics, Chichester : John Wiley & Sons, 1998
4. Bayazitoglu, Y. Ozisik, Necati M.: Elements of Heat Transfer . McGraw-Hill Book Company, New York, 1988