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-602**
Course title in Polish	**Termodynamika I**
Course title in English	**Thermodynamics I**
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**
Approved by	

COURSE OVERVIEW

Course type	**basic**
Course status	**compulsory**
Language of instruction	English
Semester of delivery	**semester 6**
Pre-requisites	**Mathematics**
Examination required (YES/NO)	NO
ECTS value	**2**

Mode of instruction	**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	**15**	**15**	**5**		

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 basic knowledge on energy, thermodynamic system and thermodynamic parameters, thermodynamic equilibrium, work and heat as methods of energy transport between systems.	MiBM1_W04 MiBM1_W21
	W02	A student will have skills concerning basic laws of physics relating to thermodynamics and the laws of thermodynamics for closed and open systems.	MiBM1_W04 MiBM1_W21
	W03	A student will have a fundamental knowledge of the ideal gas equation, polytropic processes and characteristic processes.	MiBM1_W04 MiBM1_W21
	W04	A student will have a knowledge and understanding of the heat engine, refrigeration and heat pomp cycles.	MiBM1_W04 MiBM1_W21
	W05	A student will be familiar with the following terms: phase change processes, critical parameters, triple point, parameters of of two-phase mixtures	MiBM1_W04 MiBM1_W21
	W06	A student will have a fundamental knowledge of unconventional sources of energy.	MiBM1_W04 MiBM1_W21
Skills	U01	A student will have the skills to utilize the procedures for energy balancing and methods of energy transport between systems.	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U02	A student will be able to utilize mathematical tools to solve problems related to the principles of thermodynamics. A student can interpret the obtained results.	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U03	A student will have the skills to computations in the field of typical issues of heating of a system by work transfer or by heat transfer	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U04	A student will have learning skills to utilize the ideal gas equation	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
	U05	A student will be able to present graphs of thermodynamic processes	MiBM1_U01 MiBM1_U03 MiBM1_U04 MiBM1_U20 MiBM1_U21
Competence	K01	A student will be aware of the method of generating energy and the operation of energy devices (heat engines, etc.) on the natural environment.	MiBM1_K01 MiBM1_K02 MiBM1_K03
	K02	A student will be able to work in a team during measurements and to analyse the results; a student will be aware of the importance of knowledge concerning the principles of teamwork.	MiBM1_K01 MiBM1_K02 MiBM1_K03 MiBM1_K04

COURSE CONTENT

Type of instruction*	Topics covered
lecture	1. Basic terms and definitions: energy, thermodynamic system, properties, state and thermodynamic equilibrium. Units. The zeroth law of thermodynamics.
	2. Microscopic forms of energy. The basic axiom of thermodynamics. Work and heat, moving boundary work. The first law of thermodynamics for closed systems.
	3. Specific heat, enthalpy, ideal gas equation of state, characteristic thermodynamic processes.
	4. The first law of thermodynamics for open systems (control volume). The concept of entropy, causes of entropy change, reversible and irreversible processes, entropy as a function of the state.
	5. The second law of thermodynamics. Examples of thermodynamic cycles: gas power cycles, refrigeration and heat pump cycles.
	6. Phases of a pure substance, saturated liquid, saturated liquid-vapor mixture, critical parameters, triple point, property diagrams for phase-change processes, properties of gas and two-phase mixtures.
	7. Unconventional sources of energy.
class	1. Thermodynamic parameters, physical properties of fluids, units used in thermodynamics. Basic energy balances.
	2. Ideal gas equation of state.
	3. Heat and work. Processes of ideal gases.
	4. The first law of thermodynamics for closed systems - the use of specific heat to calculate changes in internal energy and enthalpy of the air
	5. The first law of thermodynamics for closed systems – calculation the changes in internal energy and enthalpy of the vapor
	6. The first law of thermodynamics for open systems (control volume): the law of conservation of energy, flow-machines: nozzle, turbine.
	7. Carnot cycle, heat engine cycles.
laboratory	1. Organizational issues. Passing requirements. Familiarizing students with health and safety and fire protection regulations in the Laboratory of Thermodynamics. Principles of developing experimental data.
	2. Temperature measurement. Temperature measuring devices. Practical aspects of thermometers installations.
	3. Pressure measurement. Calibration of pressure gauges.

*) 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			
U02			X		X	
U03			X		X	
U04			X			
U05			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 each in-class test
laboratory	non-examination assessment	The pass mark is a minimum of 50% for each in-class test and the post-lab reports.
project	non-examination assessment	
seminar	non-examination assessment	

*) 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	5			
2.	Other contact hours (office hours, examination)	2	2	2			h
3.	**Total number of contact hours**	**41**					h
4.	**Number of ECTS credits for contact hours**	**1,6**					ECTS
5.	**Number of independent study hours**	**9**					h
6.	**Number of ECTS credits for independent study hours**	**0,4**					ECTS
7.	**Number of practical hours**	**29**					h
8.	**Number of ECTS credits for practical hours**	**1,2**					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. Yunis A. Cengel, Michael A. Boles: Thermodynamics: An Engineering Approach, eighth edition New York : McGraw-Hill Publishing Company, 2015
2. John R Howell: 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. Yıldız Bayazıtoğlu, M. Necati *Özişik*: Elements of Heat Transfer. McGraw-Hill Book Company, New York, 1988