MODULE SPECIFICATION

Module code	
Module title in Polish	Termodynamika techniczna
Module title in English	Engineering Thermodynamics
Module running from the academic year	2016/2017

A. MODULE IN THE CONTEXT OF THE PROGRAMME OF STUDY

Field of study	Environmental Engineering
Level of qualification	first cycle (first cycle, second cycle)
Programme type	academic (academic/practical)
Mode of study	full-time (full-time/part-time)
Specialism	Sanitary Pipelines and Systems; Water Supply, Treatment of Wastewater and Solid Waste
Organisational unit responsible for module delivery	Department of Piped Utility Systems
Module co-ordinator	Tadeusz Orzechowski, PhD hab., Eng., Professor of the University
Approved by:	Prof. Andrzej Kuliczkowski, PhD hab., Eng.

B. MODULE OVERVIEW

Module type	core module (core/programme-specific/elective HES*)
Module status	compulsory module (compulsory/optional)
Language of module delivery	**Polish/English**
Semester in the programme of study in which the module is taught	semester 3
Semester in the academic year in which the module is taught	winter semester (winter semester/summer semester)
Pre-requisites	None (module code/module title, where appropriate)
Examination required	Yes (Yes/No)
ECTS credits	5

* elective HES – elective modules in the Humanities and Economic and Social Sciences

Mode of instruction	lectures	classes	laboratories	project	others
Total hours per semester	15	30			

C. LEARNING OUTCOMES AND ASSESSMENT METHODS

Module aims	The aim of the module is to learn and master the fundamentals of phenomenological thermodynamics and heat exchange. The subject covers such issues as: thermodynamic system, the forms of energy, thermodynamic transitions, the principles of thermodynamics, and phase transitions.

Module outcome code	Module learning outcomes	Mode of instruction *(l/c/lab/p/ others)*	Corresponding programme outcome code	Corresponding discipline-specific outcome code
W_01	A student knows basic notions concerning thermodynamics, i.e. work, heat, internal energy, pressure, and temperature.	l/c	IŚ_W01 IŚ_W08	T1A_W01 T1A_W02 T1A_W03 T1A_W04
W_02	A student knows the zeroth and first law of thermodynamics.	l/c	IŚ_W01 IŚ_W08	T1A_W01 T1A_W02 T1A_W03 T1A_W04
W_03	A student knows Clapeyron's equation, the Avogadro law, transitions of an ideal gas, the equations of real gases and their transitions.	l/c	IŚ_W01 IŚ_W08	T1A_W01 T1A_W02 T1A_W03 T1A_W04
W_04	A student is acquainted with Molier's diagram and basic transitions of humid air.	l/c	IŚ_W01 IŚ_W08	T1A_W01 T1A_W02 T1A_W03 T1A_W04
W_05	A student is familiar with Carnot's cycle; a student has basic information on heat transfer.	l/c	IŚ_W01 IŚ_W08	T1A_W01 T1A_W02 T1A_W03 T1A_W04
U_01	A student is able to calculate basic values, e.g. work and excess pressure.	l/c	IŚ_U19	T1A_U03 T1A_U05 T1A_U07 T1A_U08 T1A_U09 T1A_U10 T1A_U11 T1A_U13 T1A_U14 T1A_U15 T1A_U16
U_02	A student can make calculations for ideal, real, and moist gas transitions.	l/c	IŚ_U19	T1A_U03 T1A_U05 T1A_U07 T1A_U08 T1A_U09 T1A_U10 T1A_U11 T1A_U13 T1A_U14 T1A_U15 T1A_U16
U_03	A student can make energy balances.	l/c	IŚ_U19	T1A_U03 T1A_U05 T1A_U07 T1A_U08 T1A_U09 T1A_U10 T1A_U11 T1A_U13 T1A_U14 T1A_U15

				T1A_U16
U_04	A student can make calculations for Carnot's cycle and those connected with heat transfer.	l/c	IŚ_U19	T1A_U03 T1A_U05 T1A_U07 T1A_U08 T1A_U09 T1A_U10 T1A_U11 T1A_U13 T1A_U14 T1A_U15 T1A_U16
K_01	A student is responsible for the reliability of the obtained results.	c	IŚ_K02 IŚ_K07	T1A_K01 T1A_K05 T1A_K07
K_02	A student can formulate conclusions and describe the results of the obtained work.	c	IŚ_K07	T1A_K07

Module content:

1. Topics to be covered in the lectures

No.	Topics	Module outcome code
1.	Discussing the syllabus of the lectures. Phenomenological thermodynamics and the applications of thermodynamics. The properties of thermodynamic systems. Closed and open systems. The forms of energy.	W_01 U_01
2.	Work, heat, and internal energy. Simple energy balances.	W_01 U_01 U_03
3.	Pressure, temperature, and the zeroth law of thermodynamics.	W_01 W_02 U_01
4.	The first law of thermodynamics for systems with controlled mass. Internal energy	W_01 W_02 U_01
5.	Clapeyron's equation, the Avogadro law, individual and universal gas constant. Transitions of an ideal gas.	W_03 U_02
6.	Real gases. The equations of real gases. Gas transitions. T-v and p-v diagrams.	W_03 U_02
7.	Carnot's cycle (energy quality). Coefficient of performance for a heat pump and a cooler.	W_05 U_04
8.	Humid air. Molier's diagram. Basic transitions of humid air.	W_04 U_02
9.	Basic information on heat transfer: conduction, convection, and radiation.	W_05 U_04
10.	Complex heat transfer.	W_05 U_04

2. Topics to be covered in the classes

No.	Topics	Module outcome code
1.	Calculating basic values: density and proper volume, excess pressure and negative pressure, and absolute pressure. The application of Archimedes' law. Basic energy balances.	W_01 U_01 U_03 K_01 K_02
2.	Calculations connected with work. The applications of the firs law of thermodynamics.	W_02 U_01 K_01 K_02

3.	Calculations for ideal, real, and humid gas transitions.	W_03 W_04 U_02 K_01 K_02
4.	Heat conduction. Convection. Complex heat transfer.	W_05 U_04 K_01 K_02

Assessment methods

Module outcome code	Assessment methods *(Method of assessment; for module skills – reference to specific project, laboratory and similar tasks)*
W_01	An examination, a test
W_02	An examination, a test
W_03	An examination, a test
W_04	An examination, a test
W_05	An examination, a test
U_01	An examination, a test
U_02	An examination, a test
U_03	An examination, a test
U_04	An examination, a test
K_01	An examination, a test
K_02	An examination, a test

D. STUDENT LEARNING ACTIVITIES

ECTS summary		
	Type of learning activity	**Study time/ credits**
1	Contact hours: participation in lectures	**15**
2	Contact hours: participation in classes	**30**
3	Contact hours: participation in laboratories	
4	Contact hours: attendance at office hours (2-3 appointments per semester)	**5**
5	Contact hours: participation in project-based classes	
6	Contact hours: meetings with a project module leader	
7	Contact hours: attendance at an examination	**10**
8		
9	**Number of contact hours**	**60** *(total)*
10	**Number of ECTS credits for contact hours**	**2.4**

	(1 ECTS credit =25-30 hours of study time)	
11	Private study hours: background reading for lectures	**20**
12	Private study hours: preparation for classes	
13	Private study hours: preparation for tests	**20**
14	Private study hours: preparation for laboratories	
15	Private study hours: writing reports	
16	Private study hours: preparation for a final test in laboratories	
17	Private study hours: preparation of a project/a design specification	
18	Private study hours: preparation for an examination	**25**
19		
20	**Number of private study hours**	**65** *(total)*
21	**Number of ECTS credits for private study hours** *(1 ECTS credit =25-30 hours of study time)*	**2.6**
22	**Total study time**	**125**
23	**Total ECTS credits for the module** *(1 ECTS credit =25-30 hours of study time)*	**5**
24	**Number of practice-based hours** *Total practice-based hours*	
25	**Number of ECTS credits for practice-based hours** *(1 ECTS credit =25-30 hours of study time)*	

E. READING LIST

References	1. Cengel Y.A., Turner R. H., Fundamentals of Thermal-Fluid Sciences, McGraw-Hill Higher Education, 2001. 2. Cengel Y.A., Boles M.A., Thermodynamics: An Engineering Approach, New York: McGraw-Hill Publishing Company, 1989. 3. Howell J.R., Fundamentals of engineering thermodynamics, New York: McGraw-Hill Book Company, 1987. 4. Moran M.J., Shapiro H.N.: Fundamentals of engineering thermodynamics, Hoboken, NJ: John Wiley & Sons, cop. 2008. 5. Wong, Kau-Fui Vincent, Thermodynamics for engineers, Boca Raton: CRC Press, cop. 2000. 6. Jou D., Casas-Vazquez J., Criado-Sancho M., Thermodynamics of fluids under flow, Berlin: Springer, cop. 2001. 7. Earl Logan, jr., Thermodynamics: processes and applications, New York: Marcel Dekker, Inc., 1999. 8. Kalyan Annamalai, Ishwar K. Puri., Advanced thermodynamics engineering, Boca Raton: CRC Press, 2002. 9. Pierre Perrot, A to Z of thermodynamics, New York: Oxford University Press, 1998. 10. Wiśniewski S., Staniszewski B., Szymanik R.; Thermodynamics of nonequilibrium processes, transl. from the polish by Eugene Lepa., Warszawa: PWN - Polish Scientific Publishers; Dordrecht; Boston: D. Reidel Publishing Company, cop. 1976. 11. Bejan A., Advanced engineering thermodynamics, Hoboken: John Wiley & Sons, cop. 2006. 12. Mahmoud Massoud, Engineering thermofluids: thermodynamics, fluid mechanics and heat transfer, Berlin: Springer, cop. 2005.
Module website	