SYLLABUS OF A MODULE

Polish name of a module	**Termodynamika**
English name of a module	**Thermodynamics**
ISCED classification - Code	0715
ISCED classification - Field of study	*Mechanics and metal trades*
Languages of instruction	*English*
Level of qualification:	*1 – BSc (EQF 6)*
Number of ECTS credit points	*6*
Examination:	*EW – exam written*

Number of hours per semester:

Lecture	Exercises	Laboratory	Seminar	E-learning	Project
30 E	30	15	0	0	0

MODULE DESCRIPTION

MODULE OBJECTIVES

O1. Understanding the fundamental energy conversion processes.
O2. Understanding and ability to use of the first and second law of thermodynamics.
O3.Understanding the pure substance properties and their mixtures.
O4.Understanding the thermodynamic cycles and cycles efficiency.

PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge on the mathematical analysis
2. Capability to use various information sources, including technical manuals.
3. Capability of individual work.
4. Data analysis and presentation of results

LEARNING OUTCOMES

LO 1 – Knowledge on fundamental energy conversion processes and thermodynamics laws

LO 2 – Knowledge on thermodynamic cycles and their efficiencies

LO 3 – Capability of thermodynamic cycles efficiency calculations

MODULE CONTENT

Type of classes – lecture	**Number of hours**
L 1-2 - Basic concepts: nature of thermodynamics, system and control volumes, continuum concept, state and equilibrium, processes and cycles, temperature and zeroth law of thermodynamics	2
L 3-6 - Energy, energy transfer, general energy analysis: internal energy, heat transfer, work, first law of thermodynamics, energy conversion efficiency	4
L 7-8 - Properties of pure substances: concept of a pure substance, phase-change processes, ideal gas, ideal gas equation of state, application of other state equations	2
L 9-10 - Energy analysis of closed systems	2
L 11-12 - Mass and energy analysis of control volume	2
L 13-14 - Second law of Thermodynamics	2
L 13-16 - Entropy and Exergy analysis	4
L 17-18 - Maxwell relations, Gibbs and Helmholtz functions	2
L 19-22 - Gas Power cycles	4
L 23-26 - Gas mixtures, gas and vapour mixtures, Rankine cycle	4
L 27-30 - Thermodynamics of chemical reactions: phase and chemical equilibrium	4
Sum	**30**
Type of classes– tutorials	**Number of hours**
T 1-2 - Basic concepts	2
T 3-6 - Energy, energy transfer, general energy analysis: internal energy, heat transfer, work, first law of thermodynamics, energy conversion efficiency	4
T 7-10 - Properties of pure substances: concept of a pure substance, phase-change processes, ideal gas, ideal gas equation of state, application of other state equations	4
T 11 -14 - Energy analysis of closed systems and Mass and energy analysis of control volume	4
T 15-18 - Second law of Thermodynamics, Entropy and exergy analysis	4
T 19-22 - Gas Power cycles	4
T 23-26 - Gas mixtures, gas and vapor mixtures	4
T 27-30 - Thermodynamics of chemical reactions	4
Sum	**30**
Type of classes– laboratory	**Number of hours**
L 1-2 Measurement precision	2
T 3-4 –Temperature measurements	2
T 5-6 – Pressure measurements	2
T 7 -8 – Mass flow rate measurements	2
T 9-10 – Specific heat capacity	2
T 11-12 – Humidity measurements	2
T 13-24 – Experimental determination of overall heat transfer coefficient	2
T 15 – Density measurements	1
Sum	**15**

TEACHING TOOLS

1 - Lecture notes
2 – Literature
3 - Thermodynamics laboratory

WAYS OF ASSESSMENT (F – FORMATIVE, S – SUMMATIVE

F1. - assessment of preparation for laboratory exercises
F2. - assessment of the ability to apply the acquired knowledge while doing the exercises
F3. - evaluation of reports on the implementation of exercises covered by the curriculum
F4. - assessment of activity during classes
S1. - assessment of the ability to solve the problems posed and the manner of presentation obtained results - pass mark *
S2. - assessment of mastery of the teaching material being the subject of the lecture - exam

*) in order to receive a credit for the module, the student is obliged to attain a passing grade in all laboratory classes as well as in achievement tests.

STUDENT'S WORKLOAD

L.p.	Forms of activity	Average number of hours required for realization of activity
1. Contact hours with teacher		
1.1	Lectures	30
1.2	Tutorials	30
1.3	Laboratory	15
1.4	Seminar	0
1.5	Project	0
1.6	Consulting teacher during their duty hours	5
1.7	Examination	3
	Total number of contact hours with teacher:	83
2. Student's individual work		
2.1	Preparation for tutorials and tests	20
2.2	Preparation for laboratory exercises, writing reports on laboratories	15
2.3	Preparation of project	0
2.4	Preparation for final lecture assessment	0
2.5	Preparation for examination	22
2.6	Individual study of literature	10
	Total number of hours of student's individual work:	67
	Overall student's workload:	150
Overall number of ECTS credits for the module		6 ECTS
Number of ECTS points that student receives in classes requiring teacher's supervision:		3.32 ECTS
Number of **ECTS** credits acquired during practical classes including laboratory exercises and projects:		2.40 ECTS

BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

1. Shavit A., Gutfinger C., Thermodynamics: From Concepts to Applications, CRC Press, 2008
2. Engel T., Reid P., Thermodynamics, Statistical Thermodynamics, & Kinetics, Benjamin Cummings, 2006
3. Janna W.S., Engineering Heat Transfer, Third Edition, CRC Press, 2009
4. Cengel, Y.A., Boles M.A., Thermodynamics, an engineering approach, 5th ed., New York, McGraw-Hill, 2006
5. Moran M.J., Shapiro H.D.: Fundamentals of engineering thermodynamics, John Wiley & Sons, 2000
6. R.E. Sonntag, C. Borgnakke, G.J. Van Wylen, Fundamentals of Thermodynamics, 6th Edition, John Wiley & Sons, 2003
7. Shavit A., Gutfinger C., Thermodynamics: From Concepts to Applications, CRC Press, 2008
8. Engel T., Reid P., Thermodynamics, Statistical Thermodynamics, & Kinetics, Benjamin Cummings, 2006

MODULE COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

prof. dr hab. inż. Andrzej Bogusławski, Katedra Maszyn Cieplnych, abogus@imc.pcz. pl