S Y L L A B U S

Course description

Course code	Course	**PODSTAWY TERMODYNAMIKI TECHNICZNEJ**
MB/O/I/ST/A.7		**FUNDAMENTALS OF TECHNICAL THERMODYNAMICS**
Language of instruction	English	
Academic year	2023/2024	

field of study:	Mechanical engineering
field of specialisation:	All
Educational level	first-cycle studies
Education profile	General academic
Mode of study	Full-time studies
Semester(s)	4

Affiliation with a group of classes		Basic classes		
Course status		Obligatory		
Types of classes, instruction hours, ECTS credits		Types of classes	Number of instruction hours	Number of ECTS credits
		Lecture	15 [h]	5 ECTS
		Classes	15 [h]	
		Laboratory	30 [h]	
Linkage of the course	with the education profile	Related to the conducted scientific activity in the discipline to which the field of study is assigned		5 ECTS
	with qualifications	It is used to acquire engineering competences by the student		5 ECTS
	with science discipline	Mechanical engineering		5 ECTS
Form of teaching		Traditional – classes organized at the University /classes conducted using online learning methods and techniques		
Prerequisites				

Department	Faculty of Mechanical Engineering
Coordinator	Phd. Dsc. Eng. Michał Pająk, prof. UTH
The website of the basic organizational unit	www.wm.uniwersytetradom.pl
E-mail address, phone number of the coordinator	m.pajak@uthrad.pl

LEARNING OUTCOMES, CURRICULUM CONTENT, TEACHING CLASSES, VERIFICATION OF LEARNING OUTCOMES

Learning Objective:	C1 - Assimilation by students of the basic laws and concepts in the field of thermodynamics. C2 - Practical use of theoretical knowledge when solving problems in the field of mathematical tasks and exercises. C2 - Preparing students to conduct scientific research.
Curriculum Content:	The content of the classes is related to the conducted scientific research. Lecture: 1. Subject and methods of thermodynamic research. Basic concepts and definitions. Substance and energy. 2. Types of energy. Work and heat as ways of transferring energy between thermodynamic systems. The first law of thermodynamics. 3. Energy balance of closed and open systems. Substance models. 4. An ideal gas as an example of a simple system. Properties, equations and characteristic transformations of ideal gases. 5. Polytropic changes. Entropy and reversibility. Irreversibility and dissipation effects. Thermodynamic cycles and model gas cycles of thermal devices. 6. Internal combustion engines, refrigerators and heating pumps. Thermal efficiency of motor circuits and coefficient of performance of cooling and heating circuits. 7. The Second Law of Thermodynamics and its equivalent formulations. Characteristic irreversible changes. Fundamentals of thermostatic gas mixtures. 8. Parameters and transformations of humid air. Saturated and superheated steam: properties and characteristic transformations. Real gases. Classes: 1. Systems of units. International System of Units SI. 2. Using the equation of state and other mathematical relationships to determine the parameters of the ideal gas state and its specific heat. 3. Balancing the energy exchange between the thermodynamic system and the environment on the basis of the first law of thermodynamics. 4. Quantitative analysis of energy conversion processes - determination of energy quantities (heat, volumetric work and technical work) characterizing reversible transformations of ideal gases. 5. Interpretation of polytropic transformations on diagrams of work and heat. 6. Qualitative analysis of energy conversion processes - determination of energy conversion efficiency on the basis of the second law of thermodynamics. 7. Determination of the thermal efficiency of engine gas cycles and coefficient of performance of gas cooling and heating cycles. 8. Calculation of parameters of humid air and analysis of its typical thermodynamic transformations. 9. Determining the properties of saturated and superheated steam using tables and graphs. 10. Interpretation of characteristic transformations of saturated and superheated steam on diagrams; work, heat and the Mollier diagram. Laboratory: 1. Measurement of the heat of combustion. 2. Measurement of the moisture content of solid fuels. 3. Determination of the characteristics of the resistance temperature sensor 4. Determination of air humidity.

	5. Marking of pressure gauges for measuring high pressures. 6. Marking micromanometers. 7. Measurements of calorific value of solid and liquid fuels. 8. Thermocouple gauge. 9. Measurement of the relative viscosity of liquids. 10. Isothermal transformation. 11. Isobaric transformation. 12 Isochoric transformation. 13. Determination of the ignition temperature of liquid fuels using the Pensky-Martens method. 14. Determination of superheated steam parameters
Didactic (educational) methods:	Conventional lecture with the use of audiovisual means, verbal problem method. Conventional classes, verbal problem method. Laboratory.
Course assessment type, the criteria for assessing the achieved learning outcomes, and the method of calculating the final grade:	The condition for passing a subject is to obtain all the required learning outcomes specified for a given subject. Obtaining positive grades in all forms of classes included in a given subject is tantamount to passing it and obtaining by the student the number of ECTS points assigned to this subject. The method of calculating the final grade for the course is specified in the study regulations.

Learning outcomes for the course in relation to the field of study learning outcomes and the type of classes				Methods of verifying learning outcomes	
Learning outcome number	Description of the learning outcomes for the course (PEU) A student who has passed the course (**W**) knows and understands / (**U**) can / (**K**) is ready to:	Field of study learning outcome (KEU)	Types of classes	Form of verification (credits)	Methods of testing and assessment
W1	can use technical terminology in the field of technical thermodynamics and solve engineering problems in the field of thermal technology.	K_WG07	Lectures Classes	Final grade	Exam
W2	has elementary knowledge in the field of technical thermodynamics required to understand the construction and operation of devices in the field of thermal technology and power engineering.	K_WG02	Laboratory	Final grade	Exam
W3	has basic knowledge of the measurement of thermodynamic parameters, knows and understands the methods of measuring the basic quantities characteristic of thermal processes, knows the calculation methods and IT tools necessary to analyze the results of the experiment;	K_WG12	Classes Laboratory	Final grade	Test
U1	can obtain information from the literature, interpret it, draw conclusions and formulate opinions	K_UW01	Classes Laboratory	Final grade	Test
U2	can use analytical and experimental methods to formulate and solve engineering tasks in the field of thermodynamics;	K_UW02	Classes Laboratory	Final grade	Test
U3	is able to conduct experiments, interpret the obtained results and draw conclusions	K_UW06	Laboratory	Final grade	Test
K1	is aware of the non-technical aspects of the activity of a mechanical engineer, including its social consequences and impact on the environment;	K_KO03	Laboratory	Verbal evaluation	Verbal evaluation

Literature and teaching aids
1. Thermodynamics: An Engineering Approach by Yunus Cengel, Michael Boles, McGraw-Hill Education, 2014 2. Fundamentals of Engineering Thermodynamics by Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Bailey, Wiley, 2018 3. Thermodynamics For Dummies by Mike Pauken, For Dummies, 2011 4. Refrigeration and Air Conditioning: An Introduction to HVAC by AHRI, Larry Jeffus, Prentice Hall, 2004

Student workload required to achieve the assumed learning outcomes – the balance of ECTS credits			
Attendance, participation	Student workload [h].		
	Other contact hours (IGK)	Student's self-study hours Classes without a teacher (ZBN**)**	Classes
Participation in ... lectures	X	X	15 [h]
Participation in .... classes/laboratory classes	X	X	15[h]/30[h]
Meeting with teachers during their duty hours	5 [h]	X	X
Preparation for lectures/classes/.... , Preparation for ... credit / exam	X	40[h] 20[h]	X
Total student workload	5 [h]/ 0,2 ECTS	60 [h]/2,4ECTS	60[h]/ 2,4 ECTS
ECTS credits for the course	5 ECTS		

Additional information, comments
In the case of students with special needs, including disabilities, and chronic illnesses, the methods and forms of verification of learning outcomes specified above (in the syllabus) are adapted to the individual needs of these students, as appropriate. Detailed rules and forms of support for students with special needs, including those with disabilities and chronically ill, during classes, credits, and exams are specified in: University Regulations (Regulamin Studiów Uniwersytetu Technologiczno-Humanistycznego w Radomiu), Study Regulations (Zasady Studiowania), and Procedure for Ensuring Accessibility of the Educational Process to Students with Special Needs, Including Those with Disabilities and Chronically ill (Procedura dotycząca zapewnienia dostępności procesu kształcenia studentom ze szczególnymi potrzebami, w tym: z niepełnosprawnością, przewlekle chorych).