POLYTECHNIC OF MEĐIMURJE IN ČAKOVEC

COURSE SYLLABUS

ACADEMIC YEAR: 2020/2021

1. GENERAL COURSE INFORMATION

1.1 Course name	**Thermodynamics**			
1.2 Study program/s	Undergraduate professional study Sustainable Development			
1.3 Course status (O,E)	O	**1.6 Mode of instruction (number of hours)**	**Lectures**	30
1.4 Course code			**Exercises**	45
1.5 Course abbreviation	TD		**Seminars**	
1.6 Semester	III		**E-learning**	
1.7 ECTS	5	**1.7 Place and time of instruction**	Premises of the Polytechnic of Međimurje in Čakovec, according to the schedule published on the website	

2. TEACHING STAFF

2.1 Course leader/s-title	Marijan Horvat, dipl.ing.str.,pred.	**contact**	mhorvat2@mev.hr
		contact	
2.2 Assistant/s- title	-	**contact**	
		contact	
2.3 Instruction held by-title	Marijan Horvat, dipl.ing.str.,pred.	**contact**	mhorvat2@mev.hr

3. COURSE DESCRIPTION

3.1 Course goals	The student will be able to evaluate thermodynamic technical systems.
3.2 Prerequisites	Basics of Energetics
3.3 Course outcomes	After successfully completing the course, students will be able to: I1 - Analyse thermodynamic quantities. I2 - Valorise gases and gas mixtures with respect to the thermodynamic context. I3 - Critically judge thermodynamic circular processes with respect to the main laws of thermodynamics. I4 - Calculate thermodynamic processes with water vapor and moist air. I5 - Categorize the combustion process. I6 - Calculate heat transfer through flat and cylindrical wall.
3.4 Course content	The course presents contents related to thermodynamics. Based on analysis, valorisation, categorization, critical judgments and calculations, the student will be able to objectively articulate certain areas of technology in which thermodynamic principles are implemented.

3.5 Types of coursework	x	Lectures	x	Exercises		Blended e-learning		Individual activities		Laboratory
		Seminars and workshops		Distant learning		Field classes		Multimedia and network		Mentorship
		Other								
3.6 Language of instruction	Croatian									
	2,5	Class attendance		Seminars		Essay				

3.7 Monitoring students' work (enter the number of ECTS credits for each activity so that the total number of ECTS credits is equal to the total ECTS value of the course, 1 ECTS = 30 hours)

	Class activity		Project		Report/paper
1,5	Midterm exams		Practical task		Continuous knowledge check
(1,5)	Written exam		Experimental work		
1,00	Oral exam		Research		

3.8 Assessment and evaluation of students' work during classes and at the final exam

Activity specification	Percent %	Points
Assessment during instruction		
Attendance	5%	5
Class activity	5%	5
Seminar/ project/ essay	25%	25
Midterm exam 1	35%	35
Midterm exam 2	30%	30
Exam assessment for the students who failed to fulfil all the obligatory requirements during the semester		
Written exam	*60%*	*60*
Total:	**100%**	**100**

3.9 Assessment criteria – analysis per learning outcomes*

	Ways of evaluating learning outcomes						
	Attendance	**Activity**	**Mid-term exam 1**	**Mid-term exam 2**	**Written exam ***	**Oral exam**	**Total**
Outcome 1			10		(10)	5	15
Outcome 2			10		(10)	5	15
Outcome 3			5	5	(10)	5	15
Outcome 4				15	(15)	5	20
Outcome 5				10	(10)	5	15
Outcome 6				5	(5)	5	10
Outcome not related	5	5					10
Total	**5**	**5**	**25**	**35**	**60**	**30**	**100**

* Students who did not pass the mid-term exam

Grading of outcomes (in order to pass the mid-term exam/exam the student must achieve at least 50% points for each learning outcome)

Points	Grade
89 – 100	excellent (5)
76 – 88	very good (4)
63 – 75	good (3)
50 – 62	pass (2)
0 – 49	fail (1)

3.10 Specific features related with taking the course

If a student does not achieve enough points on the mid-term exam, he / she cannot take the next midterm exam and access the written exam within the exam period.
The oral exam is taken by students who have collected enough points from the mid-term exam or written exam.

3.11 Students obligations

Full-time students are required to attend at least 70% of the total number of hours of lectures and exercises in order to exercise the right to take the exam. Part-time students are required to attend at least 30% of the total number of hours of lectures and exercises in order to exercise the right to take the exam. If the student has not fulfilled all the obligations set by the course, he is obliged to attend the lectures again and meet the conditions for taking the exam.

	Attendance can be offset by online tuition, organised webinars and added assignments given by teachers. One lesson lasts 45 minutes, and several hours form a teaching unit. Absence from one teaching unit is counted as one absence. Delays and apologies are recorded separately. In that case, if the student missed more than 50% of classes, and has a justifiable reason/apology, the request should be submitted to the Department Council, which then decides on the justification of student absences with the obligatory opinion of the course leader.	
3.12 Written assignments		
3.13 Required reading	1.	Bošnjaković: Nauka o toplini, sv. 1, 2 i 3,
	2.	Mađerić, Čikić: Zbirka zadataka iz termodinamike, Sveučilište Sjever 2015.
3.14 Additional reading	1.	Recknagel, Sprenger, Schramek, Čeperković: Grejanje i klimatizacija, Energetika marketing 2012.
	2.	Skupina autora: Osnove primjene biomase, Energetika marketing 2012.
	3.	Skupina autora: Osnove primjene dizalica topline, Energetika marketing 2012.
	4.	Skupina autora: Osnove primjene fotonaponskih sustava, Energetika marketing 2012.
4 ADDITIONAL COURSE INFORMATION		
4.1 Quality control	The quality of the program, teaching process, teaching skills and level of mastery of the material will be established by conducting a written evaluation based on questionnaires, and in other standardised ways and in accordance with the by-laws of the Polytechnic of Međimurje in Čakovec.	
4.2 Contact the teacher	Students can contact the teacher during the office hours and during classes, while for short questions and explanations they can contact him/her any day during working hours by coming in person or by landline. It is also possible to ask questions by e-mail, which will be answered in 48 hours at the latest. It is desirable for students to come as often as possible for any possible questions during the teacher's office hours.	
4.3 Information about the course	It is the obligation of each student to be regularly informed about the course. All notifications about the classes or possible postponement of classes will be posted on the bulletin board and on the website of the Polytechnic at least 24 hours in advance.	
4.4 Course contribution to the study program	Interpret information, ideas, problems and solutions to professional and general audiences Use new technologies and techniques as part of the lifelong learning process Use foreign languages in professional communication and use of professional literature Advocate an ethical approach to work and to associates in project teams Critically evaluate arguments, assumptions and data in order to form opinions and contribute to solving the problems Solve engineering problems of sustainable development interdisciplinary Apply the basics of thermoenergetics, thermodynamics and hydromechanics in the spatial planning of thermodynamic systems Justify the use of non-renewable and renewable energy sources and characteristic energy sources, applicable to thermotechnical systems in practice Manage water, air, soil, waste and energy in a sustainable way	
5. ANALYSIS OF COURSE TOPICS (the number of hours is equal to the number of lectures and exercises of the course)		

LECTURES				
Hours	**Topic and description**	**Method** • Direct teaching (lecture, instruction, pp presentation) • Discovery learning (individual, lead, discussion) • Group learning • Case study • Field classes…	**Learning outcomes**	**Course outcome**
1.2.	Thermodynamic quantities	Lecture, pp presentation	Analyse basic energy quantities and thermodynamic concepts	I1
3.4.	Specific heat capacity	Lecture, pp presentation	Analyse basic energy quantities and thermodynamic concepts	I1
5.6.	I. main item of thermodynamics	Lecture, pp presentation	Valorise I. main item of thermodynamics	I2
7.8.	Changes in the state of an ideal gas.	Lecture, pp presentation	Valorise the ideal gas with respect to the thermodynamic context.	I2
9.10.	Gas mixtures.	Lecture, pp presentation	Valorise gas mixtures according to the thermodynamic context.	I2
11.12.	II. main item of thermodynamics - circular processes part I	Lecture, pp presentation	Critically judge thermodynamic circular processes with respect to the main laws of thermodynamics	I3
13.14.	Circular processes part II	Lecture, pp presentation	Critically judge thermodynamic circular processes with respect to the main laws of thermodynamics	I3
15.16.	Water vapor - basics	Lecture, pp presentation	Analyse basic thermodynamic concepts related to water vapor	I4
17.18.	Water vapor - circular processes	Lecture, pp presentation	Analyze thermodynamic circular processes with water vapor	I4

19.20.	Humid air	Lecture, pp presentation	Analyse basic thermodynamic concepts related to humid air	I4
21.22.	Cooling process	Lecture, pp presentation	Analyse the cooling process.	I4
23.24.	Humid air - processes	Lecture, pp presentation	Analyse the process with humid air.	I4
25.26.	Combustion - the basics	Lecture, pp presentation	Categorize the combustion process	I5
27.28.	Heat transfer through a flat wall	Lecture, pp presentation	Analyse the basics of heat transfer through a flat wall.	I6
29.30.	Heat transfer through a cylindrical wall	Lecture, pp presentation	Analyse the basics of heat transfer through a cylindrical wall.	I6
EXERCISES/ SEMINARS				
Hours	**Topic and description**	**Method** • Direct teaching (lecture, instruction, pp presentation) • Discovery learning (individual, lead, discussion) • Group learning • Case study • Field classes…	**Learning outcomes**	**Course outcome**
1.2.3.	Calculation of thermodynamic quantities	Combination of methods	Calculate thermodynamic quantities	I1
4.5.6.	Calculation of specific heat capacity	Combination of methods	Calculate thermodynamic quantities	I1
7.8.9.	I. main item of thermodynamics	Combination of methods	Calculate the tasks related to the I main paragraph of thermodynamics	I2
10. 10. 11. 12.	Changes in the state of an ideal gas	Combination of methods	Calculate tasks related to changes in the state of an ideal gas	I2
13.14. 15.	Calculation of gas mixtures	Combination of methods	Calculate tasks related to gas mixtures	I2
16.17. 18.	II. main thermodynamics, right-handed Carnot cycle	Combination of methods	Calculate problems with a right-handed Carnot cycle	I3
19.20. 21.	I. Mid-term exam	-	-	I1+I2+I3

22.23. 24.	Calculation of left-handed circular process.	Combination of methods	Calculate tasks with left-handed circular process.	I3
25.26. 27.	Use of tables and diagrams for water vapor	Combination of methods	Calculate water vapor tasks using tables and diagrams.	I4
28.29. 30.	Calculation of one-stage turbine-cogeneration process with steam	Combination of methods	Calculate thermodynamic processes with water vapor	I4
31.32. 33.	Use of tables and diagrams for humid air.	Combination of methods	Calculate humid air tasks using tables and diagrams.	I4
34.35. 36.	Combustion process calculation	Combination of methods	Calculate combustion tasks.	I5
37.38. 39.	Calculation of heat transfer through a flat wall.	Combination of methods	Calculate tasks with heat transfer through a flat wall.	I6
40.41. 42.	Calculation of heat transfer through a cylindrical wall.	Combination of methods	Calculate tasks with heat transfer through a cylindrical wall.	I6
43.44. 45.	II. Mid-term exam	-	-	I3+I4+I5 +I6