



POLYTECHNIC OF MEĐIMURJE IN ČAKOVEC

COURSE SYLLABUS

ACADEMIC YEAR: 2021/2022

1. GENERAL COURSE INFORMATION										
1.1 Course name	Measurement in Thermotechnics									
1.2 Study program/s	Undergraduate professional study Sustainable Development									
1.3 Course status (O,E)	Election	1.6 Mode of instruction (number of hours)			Lectures	15				
1.4 Course code					Exercises	30				
1.5 Course abbreviation	MuTT				Seminars					
1.6 Semester	V				E-learning					
1.7 ECTS	4	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	prof. Sarajko Baksa, Ph.D.	contact			sbaksa@mev.hr					
	---	contact			---					
2.2 Assistant/s- title	---	contact			---					
	---	contact			---					
2.3 Instruction held by- title	---	contact			---					
3. COURSE DESCRIPTION										
3.1 Course goals	The aim of the course is to firmly define and adopt the basic principles of engineering thermotechnical measurement.									
3.2 Prerequisites	Passed courses; Thermodynamics, Energy Conversions and Fluid Mechanics.									
3.3 Course outcomes	<p>After successfully passing the course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Evaluate basic temperature measurement methods. 2. Evaluate basic methods of pressure measurement. 3. Evaluate basic methods of measuring humidity. 4. Evaluate basic flow measurement methods. 5. Evaluate basic methods of measuring thermal energy. 6. Select the type of meter for different issues related to thermal and process measurements. 7. Apply appropriate corrections to the measurement results. 8. Interpret the measurement results. 9. Perform heat balance of thermotechnical system. 10. Analyze the results of thermal and process measurements. 									
3.4 Course content	The course presents contents related to the planning and implementation of engineering thermotechnical measurement of physical processes.									
3.5 Types of coursework	x	Lectures	x	Exercises	x	Blended e-learning	x	Individual activities		Laboratory
	x	Seminars and workshops	x	Distant learning	x	Field classes	x	Multimedia and network	x	Mentorship
		Other								

3.6 Language of instruction	Croatian / English																																																																																																																						
	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)	1,5	Class attendance	0,2	Seminars		Essay																																																																																																																
			Class activity	0,2	Project		Report/paper																																																																																																																
		0,2	Midterm exams	0,2	Practical task	0,2	Continuous knowledge check																																																																																																																
		1,0	Written exam		Experimental work																																																																																																																		
		0,5	Oral exam		Research																																																																																																																		
3.8 Assessment and evaluation of students' work during classes and at the final exam	<table border="1" data-bbox="587 595 1310 958"> <thead> <tr> <th data-bbox="587 595 932 629">Activity specification</th> <th data-bbox="936 595 1121 629">Percent %</th> <th data-bbox="1126 595 1310 629">Points</th> </tr> </thead> <tbody> <tr> <td colspan="3" data-bbox="587 636 1310 658" style="text-align: center;">Assessment during instruction</td> </tr> <tr> <td data-bbox="587 665 932 687">Attendance</td> <td data-bbox="936 665 1121 687">5%</td> <td data-bbox="1126 665 1310 687">5</td> </tr> <tr> <td data-bbox="587 694 932 716">Class activity</td> <td data-bbox="936 694 1121 716">5%</td> <td data-bbox="1126 694 1310 716">5</td> </tr> <tr> <td data-bbox="587 723 932 745">Project / Practical work</td> <td data-bbox="936 723 1121 745">20%</td> <td data-bbox="1126 723 1310 745">20</td> </tr> <tr> <td data-bbox="587 752 932 775">Seminar / Colloquium I</td> <td data-bbox="936 752 1121 775">20%</td> <td data-bbox="1126 752 1310 775">20</td> </tr> <tr> <td data-bbox="587 781 932 804">Seminar / Colloquium II</td> <td data-bbox="936 781 1121 804">20%</td> <td data-bbox="1126 781 1310 804">20</td> </tr> <tr> <td data-bbox="587 810 932 833">Oral exam</td> <td data-bbox="936 810 1121 833">30%</td> <td data-bbox="1126 810 1310 833">30</td> </tr> <tr> <td colspan="3" data-bbox="587 840 1310 898" style="text-align: center;"><i>Exam assessment for the students who failed to fulfill all the obligatory requirements during the semester</i></td> </tr> <tr> <td data-bbox="587 904 932 927"><i>Written exam</i></td> <td data-bbox="936 904 1121 927">60%</td> <td data-bbox="1126 904 1310 927">60</td> </tr> <tr> <td data-bbox="587 934 932 956">Total:</td> <td data-bbox="936 934 1121 956">100%</td> <td data-bbox="1126 934 1310 956">100</td> </tr> </tbody> </table>						Activity specification	Percent %	Points	Assessment during instruction			Attendance	5%	5	Class activity	5%	5	Project / Practical work	20%	20	Seminar / Colloquium I	20%	20	Seminar / Colloquium II	20%	20	Oral exam	30%	30	<i>Exam assessment for the students who failed to fulfill all the obligatory requirements during the semester</i>			<i>Written exam</i>	60%	60	Total:	100%	100																																																																																
Activity specification	Percent %	Points																																																																																																																					
Assessment during instruction																																																																																																																							
Attendance	5%	5																																																																																																																					
Class activity	5%	5																																																																																																																					
Project / Practical work	20%	20																																																																																																																					
Seminar / Colloquium I	20%	20																																																																																																																					
Seminar / Colloquium II	20%	20																																																																																																																					
Oral exam	30%	30																																																																																																																					
<i>Exam assessment for the students who failed to fulfill all the obligatory requirements during the semester</i>																																																																																																																							
<i>Written exam</i>	60%	60																																																																																																																					
Total:	100%	100																																																																																																																					
3.9 Assessment criteria – analysis per learning outcomes	<table border="1" data-bbox="507 1050 1453 1565"> <thead> <tr> <th colspan="8" data-bbox="507 1050 1453 1084" style="text-align: center;">Ways of evaluating learning outcomes</th> </tr> <tr> <th data-bbox="507 1090 687 1167"></th> <th data-bbox="692 1090 794 1167">Attendance</th> <th data-bbox="799 1090 924 1167">Activity</th> <th data-bbox="928 1090 1037 1167">Project</th> <th data-bbox="1042 1090 1144 1167">Mid-term exam 1</th> <th data-bbox="1149 1090 1251 1167">Mid-term exam 2</th> <th data-bbox="1256 1090 1358 1167">Practic work</th> <th data-bbox="1362 1090 1453 1167">Total</th> </tr> </thead> <tbody> <tr><td data-bbox="507 1173 687 1196">Outcome 1</td><td></td><td></td><td>2</td><td>4</td><td></td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1202 687 1225">Outcome 2</td><td></td><td></td><td>2</td><td>4</td><td></td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1232 687 1254">Outcome 3</td><td></td><td></td><td>2</td><td>4</td><td></td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1261 687 1283">Outcome 4</td><td></td><td></td><td>2</td><td>4</td><td></td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1290 687 1312">Outcome 5</td><td></td><td></td><td>2</td><td>4</td><td></td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1319 687 1341">Outcome 6</td><td></td><td></td><td>2</td><td></td><td>4</td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1348 687 1370">Outcome 7</td><td></td><td></td><td>2</td><td></td><td>4</td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1377 687 1400">Outcome 8</td><td></td><td></td><td>2</td><td></td><td>4</td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1406 687 1429">Outcome 9</td><td></td><td></td><td>2</td><td></td><td>4</td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1435 687 1458">Outcome 10</td><td></td><td></td><td>2</td><td></td><td>4</td><td>3</td><td>9</td></tr> <tr><td data-bbox="507 1464 687 1532">Outcome not-related</td><td>5</td><td>5</td><td></td><td></td><td></td><td></td><td>10</td></tr> <tr><td data-bbox="507 1538 687 1561">Total</td><td>5</td><td>5</td><td>20</td><td>20</td><td>20</td><td>30</td><td>100</td></tr> </tbody> </table> <p data-bbox="507 1641 1453 1742">The course has defined 10 learning outcomes, a system of scoring outcomes, in order to pass the exam the student must achieve at least 50% points for each learning outcome.</p> <p data-bbox="507 1787 1453 1821">The grade is calculated as follows:</p> <ul data-bbox="608 1854 1107 2029" style="list-style-type: none"> • 87.51-100.00 points: rating Excellent (5) • 75.01- 87.5 points: rating Very good (4) • 62.51 -75.00 points: rating Good (3) • 50.01- 62.5 points: rating Pass (2) • 00.00- 50.00 points: rating Fail (1) 							Ways of evaluating learning outcomes									Attendance	Activity	Project	Mid-term exam 1	Mid-term exam 2	Practic work	Total	Outcome 1			2	4		3	9	Outcome 2			2	4		3	9	Outcome 3			2	4		3	9	Outcome 4			2	4		3	9	Outcome 5			2	4		3	9	Outcome 6			2		4	3	9	Outcome 7			2		4	3	9	Outcome 8			2		4	3	9	Outcome 9			2		4	3	9	Outcome 10			2		4	3	9	Outcome not-related	5	5					10	Total	5	5	20	20	20	30	100
Ways of evaluating learning outcomes																																																																																																																							
	Attendance	Activity	Project	Mid-term exam 1	Mid-term exam 2	Practic work	Total																																																																																																																
Outcome 1			2	4		3	9																																																																																																																
Outcome 2			2	4		3	9																																																																																																																
Outcome 3			2	4		3	9																																																																																																																
Outcome 4			2	4		3	9																																																																																																																
Outcome 5			2	4		3	9																																																																																																																
Outcome 6			2		4	3	9																																																																																																																
Outcome 7			2		4	3	9																																																																																																																
Outcome 8			2		4	3	9																																																																																																																
Outcome 9			2		4	3	9																																																																																																																
Outcome 10			2		4	3	9																																																																																																																
Outcome not-related	5	5					10																																																																																																																
Total	5	5	20	20	20	30	100																																																																																																																

3.10 Specific features related with taking the course	<p>If the student collects 50% of the points of each outcome, he / she directly takes the exam, provided that he / she has done practical work (seminars / project). During the exam, it is possible to orally check the knowledge from practical work (seminars / project).</p> <p>Once earned points for each learning outcome are no longer deleted unless the student, with the express approval of the course leader, decides to correct the result for each learning outcome, whereby the points won are deleted and newly earned points for that learning outcome are entered. The final grade is obtained on the exam period and is the sum of points earned during classes.</p> <p>Students who did not take the colloquium access the written part of the exam where all learning outcomes are checked, and are required to have completed practical work (seminars / project) before taking the exam.</p>	
3.11 Students obligations	<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p>	
3.12 Written assignments	Seminars / Projects	
3.13 Required reading	1.	S.Švaić i ostali: Hrvatske norme i pravilnici iz područja određivanja termotehničkih karakteristika toplinskih aparata i uređaja, mikroklima i emisije u okoliš, Toplinski laboratoriji FSB, Zagreb
3.14 Additional reading	1.	S. Šavić i ostali: Parametri mikroklima, buke, osvjetljenja i emisija u zrak, FSB, Zagreb
4 ADDITIONAL COURSE INFORMATION		
4.1 Quality control	<p>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.</p>	

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 possible to ask questions and e-mail which will be answered as soon as possible.
4.3 Information about the course	It is the obligation of each student to be regularly informed about the course. All relevant information and notices related to classes and exams, maintenance or any year, will be reported in a timely manner on the bulletin board and on the website of the Polytechnic of Međimurje in Čakovec.
4.4 Course contribution to the study program	<p>Course contribution to the study program in generic learning outcomes;</p> <p>I1 - Interpret information, ideas, problems and solutions to professional and General public, I2 - Use new technologies and techniques as part of a lifelong process Learning.</p> <p>The contribution of the course to the study program in specific learning outcomes;</p> <p>I6 - Solve engineering problems of sustainable development by applying mathematics, physics, chemistry and biology, I7 - Analyze collected data in the field of sustainable development, I8 - Interdisciplinary to solve engineering problems of sustainable development, I10 - Interpret European Union legislation in the field of sustainable development, I11 - Apply basics of thermoenergetics, thermodynamics and hydromechanics in spatial design of thermodynamic systems, I12 - Develop a technical plan in the field of design of Mechanical Thermotechnical System, I13 - Analyze the basic elements and networks in electrical engineering and justify use of non-renewable and renewable energy sources, applicable code thermotechnical systems, I14 - Apply and monitor conventional heating, cooling, and ventilation systems and devices, I15 - Maintain thermotechnical systems and thermal distribution networks I16 - Propose technical changes and upgrades to conventional ones thermotechnical systems in the direction of sustainable development, I18 - Perform an energy audit and make an energy certificate, energy renovation and certification of the building.</p>

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 <ul style="list-style-type: none"> • Direct teaching (lecture, instruction, pp presentation) • Discovery learning (individual, lead, discussion) • Group learning • Case study • Field classes... 	Learning outcomes	Course outcome

1.	Introduce students to the lecture program, teaching conditions, literature and criteria for evaluating knowledge. Fundamentals of thermotechnical measurement.	Lecture, Discovery learning, Presentation	Use knowledge of the basics of thermotechnical measurement	11
2.	Access and organization of thermotechnical measurements.	Lecture, Discovery learning, Presentation	Distinguish approach and organization of measurements.	11
3.	Thermotechnical measuring devices and method of use.	Lecture, Discovery learning, Presentation	Distinguish between systems, measuring devices and methods of use	11
4.	Measurement of basic parameters of heating, air conditioning and ventilation systems, and their components.	Lecture, Discovery learning, Presentation	Use features to measure the basic parameters of the heating, air conditioning and ventilation systems	12
5.	Measurement of microclimate parameters and air emissions.	Lecture, Discovery learning, Presentation	Use the principles of measuring the parameters of the microclimate of the environment	12
6.	Balancing of thermotechnical systems.	Lecture, Discovery learning, Presentation	Apply a variety of system balancing models	12
7.	Preparation of thermotechnical reports.	Lecture, Discovery learning, Presentation	Use and explain the input and output factors of the report	12
8.	Measurements of characteristics of elements of thermotechnical systems - water / water, water / air heat exchanger.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of heat exchangers	13
9.	Measurements of characteristics of elements of thermotechnical systems - radiators.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of radiator elements	14
10.	Measurements of characteristics of elements of thermotechnical systems - hot water boiler.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of hot water boiler systems	15
11.	Measurements of characteristics of elements of thermotechnical systems - solar collector.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of solar collector elements	16
12.	Measurements of characteristics of elements of thermotechnical systems - heating.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of heating elements	17
13.	Measurements of characteristics of elements of thermotechnical systems - cooling.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of cooling elements	18
14.	Measurements of characteristics of elements of thermotechnical	Lecture, Discovery learning, Presentation	Apply and distinguish the	19

	systems - heat recovery.		characteristics of heat recovery elements	
15.	Measurement of flue gas emissions.	Lecture, Discovery learning, Presentation	Apply various models for measuring flue gas emissions	110
EXERCISES/ SEMINARS				
Hours	Topic and description	Method <ul style="list-style-type: none"> • Direct teaching (lecture, instruction, pp presentation) • Discovery learning (individual, lead, discussion) • Group learning • Case study • Field classes... 	Learning outcomes	Course outcome
1.	Introduce students to the lecture program, teaching conditions, literature and criteria for evaluating knowledge. Fundamentals of thermotechnical measurement.	Lecture, Discovery learning, Presentation	Use knowledge of the basics of thermotechnical measurement	11
2.	Access and organization of thermotechnical measurements.	Lecture, Discovery learning, Presentation	Distinguish approach and organization of measurements.	11
3.	Thermotechnical measuring devices and method of use.	Lecture, Discovery learning, Presentation	Distinguish between systems, measuring devices and methods of use	11
4.	Measurement of basic parameters of heating, air conditioning and ventilation systems, and their components.	Lecture, Discovery learning, Presentation	Use features to measure the basic parameters of the heating, air conditioning and ventilation systems	12
5.	Measurement of microclimate parameters and air emissions.	Lecture, Discovery learning, Presentation	Use the principles of measuring the parameters of the microclimate of the environment	12
6.	Balancing of thermotechnical systems.	Lecture, Discovery learning, Presentation	Apply a variety of system balancing models	12
7.	Preparation of thermotechnical reports.	Lecture, Discovery learning, Presentation	Use and explain the input and output factors of the report	12
8.	Measurements of characteristics of elements of thermotechnical systems - water / water, water / air heat exchanger.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of heat exchangers	13
9.	Measurements of characteristics of elements of thermotechnical systems - radiators.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of radiator elements	14

10.	Measurements of characteristics of elements of thermotechnical systems - hot water boiler.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of hot water boiler systems	15
11.	Measurements of characteristics of elements of thermotechnical systems - solar collector.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of solar collector elements	16
12.	Measurements of characteristics of elements of thermotechnical systems - heating.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of heating elements	17
13.	Measurements of characteristics of elements of thermotechnical systems - cooling.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of cooling elements	18
14.	Measurements of characteristics of elements of thermotechnical systems - heat recovery.	Lecture, Discovery learning, Presentation	Apply and distinguish the characteristics of heat recovery elements	19
15.	Measurement of flue gas emissions.	Lecture, Discovery learning, Presentation	Apply various models for measuring flue gas emissions	110