



POLYTECHNIC OF MEĐIMURJE IN ČAKOVEC

COURSE SYLLABUS

ACADEMIC YEAR: 2020/2021

1. GENERAL COURSE INFORMATION

1.1 Course name	Maintenance			
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	4045		Exercises	30
1.5 Course abbreviation	O		Seminars	
1.6 Semester	4		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	dr.sc. Mario Šercer	contact	mario.sercer@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 student will be introduced to maintenance processes and accompanying elements of the organization and information systems. The service life of technical systems, development of maintenance strategies, methods of business decision-making in the selection of equipment, elaboration of technological maintenance processes and quality characteristics of technical systems will be defined.
3.2 Prerequisites	There are no conditions.
3.3 Course outcomes	After successfully completing the course, students will be able to: <ul style="list-style-type: none"> 11 - define the function and goals of maintenance; 12 - define the criteria of the maintainer in the procurement of new equipment from the aspect of maintenance and the role of maintenance in the life of the plant; 13 - classify the principles and types of maintenance in technical systems and determine the flow of information when maintenance is required 14 - define the reliability of technical systems and methods of reliability analysis; 15 - calculate the reliability of the technical system; 16 - present the importance of diagnostics in maintenance.
3.4 Course content	Through this course, the student will acquire basic theoretical and practical knowledge that will enable them to independently cope with the problems of maintenance of industrial plants and technical systems. They will also get acquainted with the knowledge in the field of organization, technology and concept (methods) of maintenance in the processes of development of technical systems, production, exploitation and disposal. In addition, students

	will be introduced to the basics of reliability of technical systems, econometrics and maintenance management.																																																																												
3.5 Types of coursework	x	Lectures	x	Exercises	Blended e-learning	Individual activities	Laboratory																																																																						
		Seminars and workshops	x	Distant learning	Field classes	Multimedia and network	Mentorship																																																																						
		Other																																																																											
3.6 Language of instruction																																																																													
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)	2	Class attendance		Seminars		Essay																																																																							
		Class activity		Project		Report/paper																																																																							
	2	Midterm exams		Practical task		Continuous knowledge check																																																																							
	2	Written exam		Experimental work																																																																									
	1	Oral exam		Research																																																																									
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Total	5	5	40	50		100																																																																							
3.10 Specific features related with taking the course	A student achieved a positive grade if he / she regularly attended classes (10%), passed the written part of the exam (90%) and the oral part of the exam (10%). Students who did not take the colloquium access the written part of the exam																																																																												

	where all learning outcomes are checked. Successfully solved two colloquia during the semester are a substitute for the written part of the exam.	
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. 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.</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		
3.13 Required reading	1.	Moubray, J.: Reliability - centered Maintenance. Industrial Press, Inc. 3rd edition, 2012.
	2.	Čala, I. et al: Inženjerski priručnik, dio 4, poglavlje 9, Školska knjiga, Zagreb, 2002.
	3.	
	4.	
3.14 Additional reading	1.	Higgins, L. R.; Mobley R.K.:Maintenance Engineering Handbook, McGraw-Hill Professional, New York, 2013.
	2.	
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	<p>Interpret information, ideas, problems and solutions to professional and general audiences</p> <p>Use new technologies and techniques as part of the lifelong learning process</p> <p>Critically evaluate arguments, assumptions and data in order to form opinions and contribute to solving the problem</p> <p>Solve engineering problems of sustainable development using mathematics, physics, chemistry and biology</p> <p>Analyze the collected data in the field of sustainable development</p> <p>Interdisciplinary to solve engineering problems of sustainable development</p> <p>Plan a circular economy in accordance with the legal framework in the Republic of Croatia</p> <p>Apply the basics of thermoenergetics, thermodynamics and hydromechanics in the spatial design of thermodynamic systems</p> <p>Develop a technical plan in the field of design of mechanical thermotechnical systems</p> <p>Analyze the basic elements and networks in electrical engineering and justify the use of non-renewable and renewable energy sources, applicable to thermotechnical systems</p> <p>Apply and monitor conventional heating, cooling and ventilation systems and devices</p> <p>Maintain thermotechnical systems and thermal distribution networks</p> <p>Propose technical changes and upgrades of conventional thermotechnical systems in the direction of sustainable development</p>
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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	Learning outcomes	Course outcome
		<ul style="list-style-type: none"> • Direct teaching (lecture, instruction, pp presentation) • Discovery learning (individual, lead, discussion) • Group learning • Case study • Field classes... 		
1.	Introduction to maintenance. Primary and secondary tasks and maintenance goals.	direct teaching	Define primary and secondary maintenance objectives.	I1
2.	Equipment quality characteristics, equipment classification. Types of failures. Manifestations of failures.	direct teaching	Explain equipment quality features and equipment classification. List the types of failures and possible manifestations of failures.	I1,I2
3.	Maintenance elements when purchasing new equipment.	direct teaching	Define maintenance elements when purchasing new equipment.	I2

4.	Maintenance strategies. Corrective maintenance.	direct teaching	Explain the types of maintenance. Define corrective maintenance.	12, 13
5.	Preventive maintenance. Condition maintenance.	direct teaching	Define preventive maintenance and condition maintenance.	12,13
6.	Mid-term exam I.	Checking outcomes I1, I2 and I3.		
7.	The notion of reliability of technical systems.	direct teaching	Define the concept of reliability of technical systems.	14
8.	Reliability indicators. Reliability analysis.	direct teaching	Define reliability indicators and methods of reliability analysis used.	14, 15
9.	Modern maintenance organization solutions and trends in the world.	direct teaching	Define modern solutions for maintenance organization.	14,15
10.	Reliability Oriented Maintenance - RCM.	direct teaching	Analyze the method of reliability of directed maintenance.	14, 15
11.	Complete efficient maintenance - TPM.	direct teaching	Analyze the method of overall effective maintenance.	14,15
12.	LEAN - maintenance.	direct teaching	List modern solutions of maintenance organization, explain LEAN maintenance.	14,15
13.	Technologies and diagnostics in maintenance.	direct teaching	Explain diagnostics in maintenance.	16
14.	Lifetime maintenance costs of industrial plants.	direct teaching	Analyze maintenance costs.	11,14,15,16
15.	Mid-term exam II.	Checking outcomes I4, I5 and I6.		
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.	Terminology in maintenance. Examples from practice.	direct teaching	Define basic concepts in maintenance and the importance of maintenance.	11
2.	Bathtub curve, decrease in working capacity of technical systems, technical indicator of correctness.	direct teaching	Explain and graphically show the bath curve.	11, 12
3.	Selection of AHP equipment by method I.	direct teaching	Apply AHP method I.	12
4.	Selection of AHP equipment by method II.	direct teaching	Apply AHP method II.	12
5.	Maintenance organization.	direct teaching	Explain the organization of maintenance.	11, 13
6.	Maintenance principles and strategies.	direct teaching	Define principles and types of maintenance.	13
7.	Tasks, responsibilities and competencies of people in maintenance.	direct teaching	Define the tasks, responsibilities and competencies of people in maintenance.	13
8.	Calculation of the required number of people on maintenance. Maintenance equipment.	direct teaching	Define maintenance equipment.	13,14
9.	Reliability indicators. Structure reliability. Malfunctions.	direct teaching	Define reliability, causes and types of failures.	14
10.	Reliability of technical systems I.	direct teaching	Calculate the reliability of technical systems.	14
11.	Reliability of technical systems II.	direct teaching	Calculate the reliability of technical systems.	14
12.	FMECA analysis.	direct teaching	Explain the FMECA method.	14
13.	Modern maintenance organization solutions and trends in the world.	direct teaching	Define modern solutions in maintenance.	15
14.	Maintenance technology in real business systems.	direct teaching	Explain maintenance technology in real business systems.	16
15.	Maintenance documentation.	direct teaching	Identify documentation in maintenance.	16