MEĐIMURJE POLYTECHNIC IN ČAKOVAC

POLYTECHNIC OF MEĐIMURJE AND ČAKOVEC

SYLLABUS COURSE				
ACADEMIC YEAR:	2020/2021			
1. GENERAL INFORMATION ABOUT THE COURSE				
. Course title	**Analytical environmental chemistry**			
. Study program (s)	Undergraduate professional study Sustainable Development			
. Course status (O, I)	O	**. Teaching methods (number of hours)**	**Lectures**	30
. Course code	40 58		**Exercises**	30
. Course abbreviation	AEC		**Seminar**	
. Semester	II I		**E-learning**	
. Credit value (ECTS)	5	**. Place and time of classes**	The premises of the Polytechnic of Međimurje in Čakovec, according to the schedule published on the website	
2. TEACHING STAFF				
. Holder / s-title	PhD, Silvija Zeman, se. lec.	**ıtact**	szeman@mev.hr	
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. Assistant / and-title		**ıtact**		
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. Contractor / title	D. Žvorc, prof. bio. and chem.	**ıtact**	dorotea.zvorc@mev.hr	
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3. COURSE DESCRIPTION				
. Course objectives	Introducing students to methods and techniques for determining the chemical composition of substances. Application of analytical methods and techniques in environmental analysis. Evaluation of analytical results.			

. Requirements for enrollment and taking the course	Chemistry in sustainable development
. Learning outcomes	1. Know and explain the interactions that occur between different phases in the environment (water-air, soil-air, water-soil) 2. Sampling (air, water, soil, sediment, biological samples). 3. Prepare and compare samples for analysis. 4. Use the acquired knowledge when sampling analytes depending on the medium 5. Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques. 6. Perform biological monitoring (environmental indicators, biomarkers)
. Course content	

. Types of teaching										
	x	Lectures	x	Exercises		Blended e-learning		Independent tasks	x	Laboratory
	x	Seminars and workshops		Distance education		Field teaching		Multimedia and network		Mentoring work
		Other:								

. Performance language						
. Monitoring student work (enter the number of ECTS credits for each activity so that the total number of ECTS credits corresponds to the credit value of the course, 1 ECTS = 30 hours)	2	Class attendance	0.5	Seminar paper		Essay
	0.5	Teaching activity		Project		Report
	1	Colloquia		Practical work		Continuous assessment
		Written exam		Experimental work		
	1	Oral exam		Research		

. Assessment and evaluation of student work during classes and at the final exam

Activity specification	**Percentage%**	**points**
Evaluation during classes		
Class attendance	5%	5
Teaching activity	5%	5

Seminar paper / project / exercises	30%	30
Colloquium 1	30%	30
Colloquium 2	30%	30
Evaluation of exam work for students who did not take the colloquium		
Written exam	*60%*	*60*
In total:	**100%**	**100**

. Evaluation criteria - elaboration by outcomes

Method of passing the outcome						
	Class attendance	**Teaching activity**	**Colloquium 1**	**Colloquium 2**	**Exercises and seminars**	**In total**
Outcome 1			10		5	15
Outcome 2			10		5	15
Outcome 3			5	5	5	15
Outcome 4				10	5	15
Outcome 5				10	5	15
Outcome 6				10	5	15
Outside the outcome	5	5				10
In total	5	5	25	35	3 0	100

Scoring outcomes (in order to pass the colloquium / exam the student must achieve at least 50% points for each learning outcome)

	Rating Points 89 - 100 Excellent (5) 76 - 88 Very good (4) 63 - 75 Good (3) 50 - 62 Enough (2) 0 - 49 Insufficient (1)
0. Specifics related to taking the course	During the semester, through two written partial tests (colloquium), students' knowledge of the material will be tested. After completing the semester, students take a written exam from the completed material. If a student collects 50% of the points of each outcome, he / she directly takes the exam, provided that he / she has done practical work (exercises). After passing the written part of the exam, the student takes the oral part of the exam. 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 exercises before taking the exam. During the exam, it is possible to check the knowledge from practical work (exercises). The final grade is obtained on the exam period and is the sum of points earned during classes. Practical work-exercises are made according to the instructions published on the Merlin system. After completing the laboratory exercises, students write a laboratory diary (or seminar) that will be checked. A student cannot access the exam period if he / she has not achieved a min for each exercise. 60 % correct answers. Practical work (completed exercises) is taught until the last week of lectures. The student has the right to miss one exercise, which he will compensate at the end of the semester or by agreement with the exercise leader.
1. Student 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 provided 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 consultations, organized 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.

2. Written works	Seminar papers (laboratory diaries) are prepared according to the instructions published on the Merlin system.	
3. Required reading	1.	Skoog, DA, West, DM Holler, FJ: Fundamentals of Analytical Chemistry (prev: Kujundžić, N., Živčić-Alegreti, V., Živković, A.), Školska knjiga Zagreb, 1999 , selected chapters
	2.	Skoog, DA, Holler, FJ, Nieman, TA: Principles of Instrumental Analysis, Brooks / Cole, Thomson Learning, 1998 (Fifth edition) , selected chapters
	3.	Fifield, FW, Haines, PJ: Environmental Analytical Chemistry, Blackwell Science, 2000, (second ed.) , Selected chapters
4. Supplementary literature	1.	Banović, M .: Analitička kemija, Školska knjiga, Zagreb, 1999.
	2.	
4. ADDITIONAL INFORMATION ABOUT THE COURSE		
. 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 standardized ways and in accordance with the acts of the Polytechnic of Međimurje in Čakovec.	
. Contacting the teacher	Students can contact the teacher during the consultation period and during classes, while for short questions and explanations they can contact 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 that students come to the consultation as often as possible for any ambiguities.	
. Informing about the course	It is the obligation of each student to be regularly informed about the course. All notifications about the holding 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.	

. The contribution of the course to the study program	Interpret information, ideas, problems and solutions to professional and general audiences Use foreign languages in professional communication and use of professional literature Advocate an ethical approach to work and to associates in project teams Solve engineering problems of sustainable development using mathematics, physics, chemistry and biology Identify significant environmental aspects within the organization for the purpose of management and compliance with standards and obligations Assess potential risks to the environment and cooperate in the preparation of environmental studies and studies on the impact of the project on the environment Organize effective work in the laboratory, independently or as part of an interdisciplinary team

5. DEVELOPMENT OF THEMATIC UNITS (the number of elaborated hours is identical to the number of lectures and exercises of the course)

LECTURES

Hours	**Topic and description of the lecture**	**Method of work** • direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning • case study • field teaching…	**Lecture learning outcomes**	**Course learning outcome**
1.	Introduction to analytical environmental chemistry - Chemical principles in the	• direct teaching (presentation, instruction, pp presentation)	Compare the chemical principles of the environment	Know and explain the interactions that occur between different phases in the environment (water-air, soil-air, water-soil)

	environment, analytical method	• Discovery learning (independent, guided, discussion, debate)	Critically consider the use of substances and their impact on the environment	
2.	Sample and sampling	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Compare and justify different sampling techniques	Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium
3./4.	Stoichiometry	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Apply mathematical knowledge and skills Apply chemical terminology and symbolism to describe the composition of a substance	ve the problem and process the data well
5./6.	Separation techniques	• direct teaching (presentation, instruction, pp presentation)	Analyze the properties, composition and type of substance Relate the structure of substances with their properties	Know and explain the interactions that occur between different phases in the environment (water-air, soil-air, water-soil)

		• Discovery learning (independent, guided, discussion, debate)	Connect experimental results with conceptual knowledge Analyze physical and chemical changes	Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium
7./8.	Chemistry of aqueous solutions - strength of acids and alkalis, hydrolysis of salts, solubility product, buffers	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate)	Analyze the properties, composition and type of substance Relate the structure of substances with their properties Connect experimental results with conceptual knowledge Analyze physical and chemical changes Observe regularities by generalizing data presented in text, drawings, tables and graphs.	ow and explain the interactions that occur between different phases in the environment (water-air, soil-air, water-soil) ve the problem and process the data well
9/10	Atmospheric chemistry	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate)	Compare the chemical principles of the environment Critically consider the use of substances and their impact on the environment Analyze the properties, composition and type of substance Relate the structure of substances with their properties	Know and explain the interactions that occur between different phases in the environment (water- air, soil-air, water-soil)

			Analyze physical and chemical changes	
11./12.	Soil chemistry	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate)	Compare the chemical principles of the environment Critically consider the use of substances and their impact on the environment Analyze the properties, composition and type of substance Relate the structure of substances with their properties Analyze physical and chemical changes	Know and explain the interactions that occur between different phases in the environment (water-air, soil-air, water-soil)
13./14.	Water chemistry	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate)	Compare the chemical principles of the environment Critically consider the use of substances and their impact on the environment Analyze the properties, composition and type of substance Relate the structure of substances with their properties Analyze physical and chemical changes	Know and explain the interactions that occur between different phases in the environment (water-air, soil-air, water-soil)

15./16.	1. Colloquium			
17.-20.	Qualitative chemical analysis -	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate)	Analyze the properties, composition and type of substance Relate the structure of substances with their properties Connect experimental results with conceptual knowledge Analyze physical and chemical changes Observe regularities by generalizing data presented in text, drawings, tables and graphs.	Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques. ve the problem and process the data well
21.-24.	Quantitative chemical analysis - gravimetry, titrimetry, electroanalysis	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate)	Analyze the properties, composition and type of substance Relate the structure of substances with their properties Connect experimental results with conceptual knowledge Analyze physical and chemical changes Observe regularities by generalizing data presented in text, drawings, tables and graphs.	Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques. ve the problem and process the data well
25./26.	Quantitative chemical analysis -	• direct teaching (presentation,	Analyze the properties, composition and type of substance	Sampling (air, water, soil, sediment, biological samples).

	spectroscopic methods	instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate)	Relate the structure of substances with their properties Connect experimental results with conceptual knowledge Analyze physical and chemical changes Observe regularities by generalizing data presented in text, drawings, tables and graphs.	Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques. ve the problem and process the data well
27./28.	Other methods of analysis - thermal, radiometric, biomonitoring	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate)	Analyze the properties, composition and type of substance Relate the structure of substances with their properties Connect experimental results with conceptual knowledge Analyze physical and chemical changes Observe regularities by generalizing data presented in text, drawings, tables and graphs.	Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques. ve the problem and process the data well Perform biological monitoring (environmental indicators, biomarkers)
29./30.	2. Colloquium			
EXERCISES / SEMINARS				

Hours	Topic and description of the lecture	Method of work • direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning • case study • field teaching…	Lecture learning outcomes	Course learning outcome
2.	Analytical methods of analysis - Interpretation and data processing. Standard deviations, errors.	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Apply mathematical knowledge and skills Observe regularities by generalizing data presented in text, drawings, tables and graphs.	ve the problem and process the data well
4.	Stoichiometry - Evaluation of analytical results, relevant reactant	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent,	Apply mathematical knowledge and skills Apply chemical terminology and symbolism to describe the composition of a substance	ve the problem and process the data well

		guided, discussion, debate) • Group / collaborative learning		
6.	Chromatography	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Connect experimental results with conceptual knowledge Analyze physical and chemical changes Observe regularities by generalizing data presented in text, drawings, tables and graphs. Apply mathematical knowledge and skills	ve the problem and process the data well Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis. Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques.
8.	Chemistry of aqueous solutions - Quantitative expression of solution composition - expression of concentrations, pH	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Apply mathematical knowledge and skills Apply chemical terminology and symbolism to describe the composition of a substance	ve the problem and process the data well Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques.

.0	Calculations of flue gas composition determination data	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Apply mathematical knowledge and skills	ve the problem and process the data well
-12.	Soil analysis - sampling and determination of temperature, pH	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Apply mathematical knowledge and skills Apply chemical terminology and symbolism to describe the composition of a substance Connect experimental results with conceptual knowledge Observe regularities by generalizing data presented in text, drawings, tables and graphs.	ve the problem and process the data well Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques.
/16.	Water analysis - sampling and determination of temperature, pH, statistical processing	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent,	Apply mathematical knowledge and skills Apply chemical terminology and symbolism to describe the composition of a substance	ve the problem and process the data well Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis.

		guided, discussion, debate) • Group / collaborative learning	Connect experimental results with conceptual knowledge Observe regularities by generalizing data presented in text, drawings, tables and graphs.	Use the knowledge gained when sampling analytes depending on the medium Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques.
-20.	Qualitative analysis of water and soil samples - detection of chloride, carbonate, iron, nitrate, phosphate, sulfate	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Apply chemical terminology and symbolism to describe the composition of a substance Analyze the properties, composition and type of substance Connect experimental results with conceptual knowledge Observe regularities by generalizing data presented in text, drawings, tables and graphs.	ve the problem and process the data well Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques.
/22.	P o lucrative analysis of water and soil	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate)	Apply mathematical knowledge and skills Connect experimental results with conceptual knowledge Observe regularities by generalizing data presented in text, drawings, tables and graphs.	ve the problem and process the data well Sampling (air, water, soil, sediment, biological samples). Prepare and compare samples for analysis. Use the knowledge gained when sampling analytes depending on the medium

		• Group / collaborative learning		Use different techniques for environmental analysis (classical methods, instrumental methods, electroanalytical techniques, other techniques.
/24.	Calculations of quantitative measurement data	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Apply mathematical knowledge and skills Observe regularities by generalizing data presented in text, drawings, tables and graphs.	ve the problem and process the data well
/26.	Spectrometric measurement data calculations	• direct teaching (presentation, instruction, pp presentation) • Discovery learning (independent, guided, discussion, debate) • Group / collaborative learning	Apply mathematical knowledge and skills	ve the problem and process the data well
/30.	Statistical processing of the results of the analysis of given samples from	• direct teaching (presentation, instruction, pp presentation)	Apply mathematical knowledge and skills	ve the problem and process the data well

	the environment (air, water, soil)	• Discovery learning (independent, guided, discussion, debate)	Observe regularities by generalizing data presented in text, drawings, tables and graphs.	