



1. GENERAL INFORMATION				
1.1. Course teacher	Assist. Prof. Ante Prkić, PhD Prof. Marina Trgo, PhD		1.6. Year of the study	1 <sup>st</sup> year (2 <sup>nd</sup> semester)
1.2. Name of the course	Modern Analytical Methods for Water and Air Quality Monitoring		1.7. ECTS credits	5
1.3. Associate teachers	Assist. Prof. Ivona Nuić, PhD Marin Ugrina, PhD		1.8. Type of instruction (number of hours L + E + S + e-learning)	Total: 60 (L:30, E30,S:0)
1.4. Study programme (undergraduate, graduate, integrated)	Graduate		1.9. Expected enrolment in the course	10
1.5. Status of the course	<input type="checkbox"/> mandatory	<input checked="" type="checkbox"/> elective	1.10. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2
2. COUSE DESCRIPTION				
2.1. Course objectives	Acquisition of basic knowledge of physical methods of analysis based on spectroscopic and electrochemical phenomena. Enabling students to understand and apply the acquired knowledge in practice for analysing water and air samples			
2.2. Enrolment requirements and/or entry competences required for the course				
2.3. Learning outcomes at the level of the programme to which the course contributes	<ul style="list-style-type: none"><li>• Compile and apply advanced knowledge of natural and technical sciences, particularly chemical engineering and environmental engineering in solving scientific, professional and general social problems.</li><li>• Solve engineering problems using the scientific method combining expert knowledge from chemistry, environmental, and chemical engineering as well as material science and engineering.</li><li>• Correlate expert knowledge from chemistry, chemical engineering and material engineering with awareness of influence on society, economy and environment.</li><li>• Plan and independently perform experiments in order to confirm a hypothesis to estimate economic and ecological efficiency of processes.</li><li>• Utilise advanced laboratory procedures and instruments for synthesis of new products, create sustainable processes, and solve problems of water, air and soil pollution.</li><li>• Apply different analytical techniques, analytical and numerical methods, as well as software tools in creative problem solving of engineering challenges, proposing sustainable technological solutions.</li><li>• Optimise complete and sustainable technological processes using analysis and modelling aimed at waste minimization utilising the strategy of the closed cycle manufacturing.</li></ul>			



	<ul style="list-style-type: none"><li>• Plan, document and monitor developmental activities of complex sustainable technological systems and processes.</li><li>• Identify and analyse complex problems in technological processes of chemical and related industries.</li><li>• Apply tools, methods and standards for monitoring and assessing the quality of processes and products, as well as their environmental impact, and to predict potential risks in working with technological processes and developing products.</li><li>• Identify and discuss advantages, disadvantages and limitations of certain methods for preparation, synthesis, analysis and processing of samples in accordance with sustainable development and life cycle of products and processes.</li><li>• Independently organise and plan timelines, apply a general methodology for project planning and management in a business environment</li><li>• Evaluate technological processes and products from the perspective of high functionality in different conditions and environmental effects.</li><li>• Create a critical analysis, evaluation and interpretation of personal results, and compare them with existing data in scientific and expert literature</li><li>• Demonstrate independence and reliability in independent work, as well as effectiveness, reliability and adaptability in team work</li><li>• Outline results of independent and teamwork in a written and oral form to non-experts and experts in a clear and coherent way.</li><li>• Communicate with the scientific and professional community, as well as society in general in local and international surroundings</li><li>• Develop work ethic, personal responsibility and tendency for further skill and knowledge acquisition, according to standards of engineering practice</li></ul>
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	<ol style="list-style-type: none"><li>1. Explain principles and possibilities of application of spectroscopic techniques for the analysis of water and air samples</li><li>2. Explain and apply methods of preparation of water and air sample for chemical analysis</li><li>3. Apply spectrometric analysis methods in water and air sample analysis.</li><li>4. Apply the separation methods of analysis in the analysis of water and air samples.</li><li>5. Apply principles of validation of analytical procedure for analysis of water and air samples.</li></ol>
2.5. Course content (syllabus)	<p><b>WEEK 1.</b> Analytical System. Errors in analysis.</p> <p><b>WEEK 2.</b> Sampling of the environment. Processing a real sample for analysis.</p> <p><b>WEEK 3.</b> Methods of Isolation of Analytes from the Matrix: Solid Phase Extraction, Microwave Extraction, Microwave Digestion.</p> <p><b>WEEK 4.</b> UV / Vis / IR spectrophotometry.</p> <p><b>WEEK 5.</b> Application of UV / Vis / IR spectrophotometry in environmental analysis</p> <p><b>WEEK 6.</b> X-ray Techniques. Electronic microscopy. Mass spectroscopy.</p> <p><b>WEEK 7.</b> Atomic absorption spectroscopy (flame, absorption, fluorescence).</p> <p><b>WEEK 8.</b> Partial exam</p> <p><b>WEEK 9.</b> Application of UV / Vis / IR spectrophotometry in environmental analysis. Chromatographic methods: gas, liquid, ionic, thin layer chromatography.</p> <p><b>WEEK 10.</b> Ion Chromatography. Detection methods in ionic chromatography.</p> <p><b>WEEK 11.</b> Application of ionic chromatography in environmental analysis</p>



	<p><b>WEEK 12.</b> Flow Analysis Methods (FIA, SIA)  <b>WEEK 13.</b> Applying Flow Analysis Method in Environmental Analysis  <b>WEEK 14.</b> Electroanalytic Methods - Potentiometry and Potentiometric Sensors. Application of potentiometric sensors in environmental analysis  <b>WEEK 15.</b> Partial exam.</p> <p>Exercises:          1. Microwave digestion of a solid/liquid sample          2. Thermal digestion of a solid/liquid sample          3. Determination of the amount of metal by atomic absorption spectroscopy          4. Determination of the amount by ionic chromatography          5. Determination of the amount potentiometrically          6. Determination of nitrogen content by Kjeldahl</p>								
2.6. Format of instruction:	<input checked="" type="checkbox"/> lectures <input type="checkbox"/> seminars and workshops <input checked="" type="checkbox"/> exercises <input type="checkbox"/> online in entirety <input type="checkbox"/> partial e-learning <input type="checkbox"/> field work			<input type="checkbox"/> independent assignments <input type="checkbox"/> multimedia and the internet <input checked="" type="checkbox"/> laboratory <input type="checkbox"/> work with mentor <input type="checkbox"/> (other)			2.7. Comments:		
2.8. Student responsibilities									
2.9. Monitoring student work	Class attendance	YES		Research		NO	Oral exam	YES	
	Experimental work		NO	Report		NO	(other)		
	Essay		NO	Seminar paper	YES		(other)		
	Preliminary exam	YES		Practical work		NO	(other)		
	Project		NO	Written exam		NO	ECTS credits (total)	5	
2.10. Required literature (available in the library and/or via other media)	<b>Title</b>						<b>Number of copies in the library</b>	<b>Availability via other media</b>	
	A. Skoog, D. M. West, F. J. Holler, S. R. Crouch, Fundamentals of Analytical Chemistry, 9th edition, Brooks&Cole, SAD, 2014.						1		
	D.C.Harris, Quantitative Chemical Analysis, 8th Edition, W.H.Freeman and Company, New York, 2010.						1		
	F. J. Holler, A. Skoog, S. R. Crouch, Principles of Instrumental Analysis, 6th edition, Cengage, SAD, 2007.						1		



University of  
Zagreb



2.11. Optional literature	
2.12. Other (as the proposer wishes to add)	