



## 1. GENERAL INFORMATION

<b>Study programme title</b>	University Graduate Study Programme in Geological Engineering				
<b>Course title</b>	Environmental monitoring	<b>Semester</b>	Summer		
<b>Teacher</b>	Assist. Prof. Stanko Ružičić, PhD	<b>Course code</b>	27259		
<b>Course type</b>	<input checked="" type="checkbox"/> obligatory <input type="checkbox"/> elective	<b>ECTS</b>	6		
<b>Location</b>	Faculty of Mining, Geology and Petroleum Engineering, Pierottijeva 6, Zagreb				
<b>Language</b>	<input type="checkbox"/> Croatian <input checked="" type="checkbox"/> English				
<b>Class type</b>	<b>Weekly hours</b>	<b>Teaching staff</b>	<b>Office hours</b>	<b>Room</b>	<b>E-mail</b>
<b>Class</b>	2	Assis. Prof. Stanko Ružičić, PhD	Monday 8-10 p.m.	P6 316	stanko.ruzicic@rgn.hr
<b>Practice</b>	2	Michaela Hruškova, PhD	Monday 10-12 p.m.	P6 303	michaela.hruskova@rgn.hr
<b>Field lecture</b>					
<b>E-learning level</b>	2	<b>Percentage of on-line class (max. 20%)</b>		15%	

## 2. COURSE DESCRIPTION

<b>Course aims</b>	<p>Major goals of this course are:</p> <ul style="list-style-type: none"> <li>- to teach students about various methods of monitoring (field sampling and laboratory analyses; data acquisition system) chemical and physical parameters of soil/sediment, water and air;</li> <li>- define various chemical and physical contaminants;</li> <li>- create model of water flow and solute transport of contaminants through unsaturated zone.</li> </ul>
<b>Requirements for applicants</b>	No requirements.
<b>Programme level learning outcomes with course contribution</b>	-
<b>Expected course level learning outcomes (4-10 outcomes)</b>	<p>Students will be able to:</p> <ul style="list-style-type: none"> <li>- calculate hydraulic parameters of unsaturated zone;</li> </ul>

	<ul style="list-style-type: none"> <li>- create model of water flow and solute transport in unsaturated zone;</li> <li>- point out places with higher concentrations of specific contaminants on maps with sources of contamination;</li> <li>- create conceptual model for water modelling and solute transport with available data;</li> <li>- sample soil and water for laboratory analyses on specific site.</li> </ul>
Course contents by individual lessons	
Class	Practice
P1 – INTRODUCTION TO ENVIRONMENTAL MONITORING	V1 - Data quality in environmental monitoring
P2 - SOIL PHYSICAL PARAMETRES	V2 – Determination of soil density and texture – sieving methods
P3 - SOIL CHEMICAL PARAMETRES	V3 - Determination of soil texture- aerometer
P4 - SOIL AND UNSATURATED ZONE MONITORING	V4 – Representation of soil monitoring equipment on the field
P5 - STATISTICAL METHODS IN ENVIRONMENTAL MONITORING	V5 – Calculation methods
P6 - PHYSICAL AND CHEMICAL CONTAMINANTS	V6 – Representation of tracing experiment in laboratory
P7 - HYDRUS 1D MODEL IN ENVIRONMENT	V7 – Calculation of specific problem using Hydrus 1D
P8 - HYDRUS 1D MODEL IN ENVIRONMENT	V8 - Calculation of specific problem using Hydrus 1D
P9 –SAMPLING METHODS FOR VARIOUS ANALYSES	V9 - Representation of sample methods on the field
P10 – PRESENTATION OF CROATIAN AGENCY FOR ENVIRONMENT AND NATURE	V10 – Browsing Croatian agency for environment and nature data base
P11 - CENTRAL WASTEWATER TREATMENT PLANT ZAGREB	V11 – Visitation of Central wastewater treatment plant Zagreb
P12 - GROUNDWATER MONITORING	V12 - Visitation of well field at Zagreb aquifer system

P13 - SURFACE WATER MONITORING	V13 - Water sampling on Bundek lake			
P14 - AIR MONITORING	V14 - Visitation of Croatian Meteorological and Hydrological Service laboratory for air quality			
P15 - SOIL REMEDIATION	V15 – Presentation of different examples of soil remediation in the world			
<b>Students' obligations</b>	Regular presence at the class (maximum absence 3 + 1). Laboratory exercises accepted by teacher. Model in Hydrus 1D accepted by teacher.			
<b>Students' work track</b> <i>(indicate share in ECTS points for each activity so that overall ECTS number corresponds to class credits score):</i>	Class attendance	2	Research	-
	Project	-	Report	-
	Colloquium	2	Seminar paper	-
	Practical work	2	Oral exam	-
	Written exam	-	(Extra)	-
<b>Type of exam, grades and evaluation of students work</b> during class and on final exam	Regular presence at the class (maximum absence 3 + 1). Laboratory exercises accepted by teacher. Model in Hydrus 1D accepted by teacher.  2 colloquiums (max. 60 points); Hydrus model problem (max. 10 points); laboratory exercises (max. 30 points).			
<b>Mandatory literature</b> (available in the Library and via other media)	Teaching materials are available on Merlin site.			
<b>Additional literature</b> (at the moment of study program proposition application)	<p>Books:</p> <p>Environmental Monitoring and Characterization Artiola, J.F., Pepper, I.L., Brusseau, M.L. (2004), Elsevier, 410 str.</p> <p>Environmental Geology Knödel, K., Lange, G., Voigt, H.J. (2007), Springer, 1357 str.</p> <p>Soil Physics with Hydrus-Modeling and Applications Radcliffe, D. E. and Šimunek, J. (2010), CRC Press, 373 str.</p> <p>Journals:</p> <p>Environmental Geology; Science of the Total Environment; Applied Geochemistry; Journal of Geochemical Exploration; Journal of soil and sediments</p>			
<b>Examination terms</b>	According to the agreement with the students.			