

1. GENERAL INFORMATION					
Study programme title	Graduate study of Geological Engineering				
Course title	Groundwater Flow and Contaminant Transport Modelling		Semester	Winter	
Teacher	Professor Kristijan Posavec		Course code		
Course type	<input type="checkbox"/> obligatory <input checked="" type="checkbox"/> elective		ECTS	6	
Location	Faculty of Mining, Geology and Petroleum Engineering, Pierottijeva 6, Zagreb				
Language	<input type="checkbox"/> Croatian <input checked="" type="checkbox"/> English				
Class type	Weekly hours	Teaching staff	Office hours	Room	E-mail
Class	2	Prof. Kristijan Posavec	Wednesday 11-13 p.m.	V 405	kristijan.posavec@rgn.hr
Practice	3	Prof. Kristijan Posavec	Wednesday 11-13 p.m.	V 405	kristijan.posavec@rgn.hr
Field lecture	-	-	-	-	-
E-learning level	1	Percentage of on-line class (max. 20%)			0%
2. COURSE DESCRIPTION					
Course aims	The course gives an overview of the theory of groundwater flow and contaminant transport with application to the case study problems. The course objectives are: (1) to describe the meaning of physical models and their role in decision making; (2) to create conceptual models and select appropriate mathematical models; (3) to select appropriate analytical or numerical methods to solve mathematical models; (4) to apply computer codes to solve groundwater flow and contaminant transport for selected case study problems; and (5) to interpret obtained modelling results.				
Requirements for applicants	-				
Programme level learning outcomes with course contribution					
Expected course level learning outcomes (4-10 outcomes)	- describe the meaning of physical models and their role in decision making,				

	<ul style="list-style-type: none"> - define conceptual models, i.e. geometry, parameters and boundary conditions of the system, - select appropriate mathematical models for given conceptual models, - select appropriate analytical or numerical methods to solve mathematical models, - apply computer codes to solve groundwater flow and contaminant transport for selected case study problems, - interpret obtained modelling results.
Course contents by individual lessons	
Class	Practice
L1 – Introduction / Models in hydrogeology	P1 – Overview of the basic theory of hydrogeology and associated basic mathematics
L2 – Groundwater flow modelling – conceptual models	P2 – Overview of the basic theory of hydrogeology and associated basic mathematics
L3 – Groundwater flow modelling –governing equations, initial and boundary conditions	P3 – Examples of boundary conditions, image wells
L4 – Analytical methods for solving groundwater flow – steady state flow	P4 – Analytical methods for solving groundwater flow – solving problems with freely available codes
L5 – Analytical methods for solving groundwater flow – transient flow	P5 – Analytical methods for solving groundwater flow – solving problems with freely available codes
L6 – Numerical methods for solving groundwater flow – steady state flow	P6 – Colloquium – Analytical methods for solving groundwater flow
L7 – Numerical methods for solving groundwater flow – transient flow	P7 – Numerical methods for solving groundwater flow – solving problems with MODFLOW code
L8 – Contaminant transport modelling – basic theory	P8 – Numerical methods for solving groundwater flow – solving problems with MODFLOW code
L9 – Contaminant transport modelling – basic theory	P9 – Colloquium – Numerical methods for solving groundwater flow
L10 – Analytical methods for solving contaminant transport	P10 – Analytical methods for solving contaminant transport – solving problems with MODFLOW and MT3DMS code
L11 – Numerical methods for solving contaminant transport	P11 – Numerical methods for solving contaminant transport – solving problems with MODFLOW and MT3DMS code

L12 – Project: a case study problem – solving groundwater flow and contaminant transport using Visual Modflow	P12 – Colloquium – Numerical methods for solving contaminant transport			
L13 – Project: a case study problem – solving groundwater flow and contaminant transport using Visual Modflow	P13 – Project: a case study problem – solving groundwater flow and contaminant transport using Visual Modflow			
L14 – Project: a case study problem – solving groundwater flow and contaminant transport using Visual Modflow	P14 – Project: a case study problem – solving groundwater flow and contaminant transport using Visual Modflow			
L15 – Project: presentation of results and discussion	P15 – Project: presentation of results and discussion			
Students' obligations	Students are expected to attend lectures and exercises and to complete given tasks on time.			
Students' work track <i>(indicate share in ECTS points for each activity so that overall ECTS number corresponds to class credits score):</i>	Class attendance	1,2	Research	-
	Project	1,2	Report	-
	Colloquium	3,6	Seminar paper	-
	Practical work	-	Oral exam	An option for the final grade improvement
	Written exam	-	(Extra)	-
Type of exam, grades and evaluation of students work during class and on final exam	The course is examined through colloquiums and project (80% or 4.8 ECTS). Students activity in the classroom, i.e. their participation in discussion and solving of given problems is also evaluated (20% or 1.2 ECTS). Oral exam is an option for students who want to improve their final grade.			
Mandatory literature (available in the Library and via other media)	-			
Additional literature (at the moment of study program proposition application)	Spitz, K. & Moreno, J.(1996): A Practical Guide to Groundwater and Solute Transport Modeling, John Wiley & Sons, Inc. Wang, H. F. and Anderson, M. P., (1982): Introduction to groundwater modeling. Academic Press, San Diego. Zheng, C. & Bennett, D. (1995): Applied Contaminant Transport Modeling, Van Nostrand Reinhold.			
Examination terms				