

1. GENERAL INFORMATION						
Study programme title	Graduate study of Mining Engineering					
Course title	Blasting 2			Semester	Summer	
Teacher	Assoc.Prof. Mario Dobrilović, PhD;			Course code	27257	
Course type	<input checked="" type="checkbox"/> obligatory <input type="checkbox"/> elective			ECTS	5,5	
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	Assoc.Prof. Mario Dobrilović, PhD	Every working day (10 a.m. – 2 p.m.).	V 228	mario.dobrilovic@rgn.hr	
Practice	2	Asst. Prof. Vinko Škrlec, PhD	Every working day (10 a.m. – 2 p.m.).	V 223	vinko.skrlec@rgn.hr	
Field lecture	0,5	Assoc.Prof. Mario Dobrilović, PhD; Asst. Prof. Vinko Škrlec, PhD		V 228 V223	mario.dobrilovic@rgn.hr vinko.skrlec@rgn.hr	
E-learning level	1		Percentage of on-line class (max. 20%)		0	
2. COURSE DESCRIPTION						
Course aims	<p>Major goals of this course are:</p> <ul style="list-style-type: none"> - Design, execution and supervision of excavation and blasting works during the exploitation of mineral resources, construction of infrastructure facilities: roads, construction pits, hydropower facilities of underground rooms and tunnels, and other facilities 					

	<ul style="list-style-type: none"> - Design, execution and supervision of special mining works such as demolition of buildings and underwater blasting
Requirements for applicants	Blasting 1. Pass.
Programme level learning outcomes with course contribution	
Expected course level learning outcomes (4-10 outcomes)	<p>Students will be able to:</p> <ul style="list-style-type: none"> - Define blasting technologies (level 1) - Describe the legislation in the field of explosives and mining related to blasting (level 1) - Explain the processes of detonation of explosives on the environment - rock, water, air (level 2) - Select and calculate blasting parameters for individual types of blasting (level 3) - Recommend blasting method (level 5) - Plan and organize mining operations (level 5) - Predict the impact of blasting on the environment (level 6) - Select blasting technique and parameters with respect to rock mass, efficiency and blasting costs (level 5)
Course contents by individual lessons	
Class	Practice
<p>C1</p> <ul style="list-style-type: none"> - Introducing students to the program, program goals - Introducing students to literature, - Introducing students to the method of testing and testing knowledge 	<p>P1 – INTRODUCTION</p> <ul style="list-style-type: none"> - Introducing students to the program, program goals - Introducing students to literature, - Introducing students to the method of testing and testing knowledge
<p>C2 - BLASTING WITH DEEP MINING WELLS</p> <ul style="list-style-type: none"> - Fraction physics, free surface, - Drilling of mine wells, drilling physics, basic principles of drilling, diameters, tools, adaptability to rock conditions, depth hammer, external hammer-application of a particular method, - Basic calculations- reliability in relation to rock conditions, (Langefors-criticism and advantages), formation of floors 	<p>P2 – BLASTING WITH DEEP MINING WELLS</p> <ul style="list-style-type: none"> - Basic calculations - Blasting parameters with deep mine wells, - Examples from practice, - Video materials.

<p>-W, a, m, g, s, f, q and so on.</p> <p>- blocking (types and effect), activation, initiation (types of initial means), connection (examples)</p>	
<p>C3 - METHODS FOR DETERMINING "IN SITU" PARAMETERS</p> <p>1. Method of linear magnification of the shoot - description of models, processing of measurement results</p> <p>2. Livingston's method, - description of models, processing of measurement results</p> <p>3. Equivalent method, - description of models, processing of measurement results</p>	<p>P3 – BLASTING WITH DEEP MINING WELLS</p> <p>- Construction of the programme</p>
<p>C4 - MINING METHODS WITH SHALLOW MINING WELLS</p> <p>- Fraction physics at one free surface, - Fold, types: parallel and oblique, model tests, - Basic calculations (Langefors-Olofson), - blocking (types and effect), activation, initiation (types initial funds), linking (examples), - contour blasting, filling construction, initiation - preparation of explosives on the spot - chemical sensitization</p>	<p>P4 – MINING METHODS WITH SHALLOW MINING WELLS</p> <p>- Basic calculations - Blasting parameters with shallow mine wells, - Examples from practice</p>
<p>C5 - MINING OF LOW FLOORS</p> <p>- calculation methods, CHANNEL MINING</p> <p>- types of mining calculations according to the width of the channel - two-row, three-row and four-row blasting, - construction of explosive charge, - method of connection and order of mine firing.</p>	<p>P5 – MINING METHODS WITH SHALLOW MINING WELLS</p> <p>- Construction of the programme</p>
<p>C6 - UNDERWATER MINING</p> <p>- Organization of construction sites, - Drilling of mine wells - Choice of explosives and initial means - Calculation of the required amount of explosive charge - A way of connecting and initiating.</p>	<p>P6 – EXCAVATION OF CHANNELS BY MINING AND MINING OF LOW FLOORS</p> <p>- Basic calculations - Low-level blasting parameters and blasting during canal excavation - Examples from practice,</p>
<p>C7 – CONTOUR MINING</p>	<p>P7 – UNDERWATER MINING</p>

<ul style="list-style-type: none"> - Theoretical explanation of contour crack formation - Types of contour blasting: pre-blasting, smooth blasting, air deck, - construction of explosive charge, initiation, - examples from practice 	<ul style="list-style-type: none"> - Basic calculations, - Blasting parameters for underwater blasting, - Examples from practice
<p>C8 – SPECIAL BLASTING</p> <ul style="list-style-type: none"> - Secondary blasting, examples and calculations - Boiler blasting, blasting stumps, ice, avalanche - Cleaning the silo by blasting 	<p>P8 – HARMFUL EFFECTS OF BLASTING AND PROTECTION</p> <ul style="list-style-type: none"> - Seismic effects of blasting - Basic calculations - Examples from practice
<p>C9 – BLASTING OF BUILDINGS</p> <ul style="list-style-type: none"> - Basics of object statics - Calculation of explosive filling for reinforced concrete, concrete, brick, wood and steel (cumulative explosive filling), - Public relations, - Organization of construction sites, - Modeling methods: rotation and collapse, and a new method - combination, - Demolition of buildings, bridges, chimneys, foundations, underwater structures - Protection against rejection, air shock and seismic effects. 	<p>P9 – HARMFUL EFFECTS OF BLASTING AND PROTECTION</p> <ul style="list-style-type: none"> - Seismic effects of blasting - program development
<p>C10 – BLASTING OF BUILDINGS</p> <ul style="list-style-type: none"> - Construction site organization, - Modeling methods: rotation and collapse, and a new method - combination, - Demolition of buildings, bridges, chimneys, foundations, underwater structures - Rejection protection, air shock wave. 	<p>P10 – HARMFUL EFFECTS OF BLASTING AND PROTECTION</p> <ul style="list-style-type: none"> - Air shock wave, - Disposal of demined material, - Basic calculations - Examples from practice
<p>C11 – HARMFUL EFFECTS OF BLASTING AND PROTECTION</p> <p>1. Seismic effects of blasting,</p> <ul style="list-style-type: none"> - Fundamentals of seismic effects, soil oscillations - Standards and regulations (DIN 4150, USBM, etc.), - Measuring instruments, sizes to be measured 	<p>P11 – SPECIAL BLASTING</p> <ul style="list-style-type: none"> - Basic calculations - Examples from practice

<p>- Determination of the maximum allowed amount of filling</p>				
<p>C12 – HARMFUL EFFECTS OF BLASTING AND PROTECTION 2. Air shock wave -Theoretical bases of air shock wave formation, -Security zone calculation, air strike reduction method 3. Disposal of mined material -Methods for reducing rejection (plug, initiation, drilling).</p>	<p>P12 – BLASTING OF BUILDINGS</p> <ul style="list-style-type: none"> - Basic calculations 			
<p>C13 – ECONOMICS OF MINING - Fragmentation-oversized pieces -Calculation of drilling works, (m³ / kn, m³ / kn), - Calculation of explosives-according to mining norms, (m³ / kn, m³ / kn), - Floor height and costs of drilling and blasting, - The cost of drilling and blasting in the total cost of exploitation</p>	<p>P13 – BLASTING OF BUILDINGS</p> <ul style="list-style-type: none"> - Examples from practice - Video materials 			
<p>C14 – CONSTRUCTION SITE ORGANIZATION IN MINING WORKS - Preparation of drilling works, staking out of the minefield, - Supply of explosives, transport and storage, - Preparations and organization of the minefield, necessary records and documentation, preparation of explosive charges on the spot, filling and connection, implementation of necessary protection measures</p>	<p>P14 – Field exercises</p>			
<p>C15 – Repetition. Typical questions for oral examination.</p>	<p>P15 – Repetition and preparation for written exam.</p>			
<p>Students' obligations</p>	<p>The student is obliged to do all the exercises and fieldwork, and attend 80% of the lectures. Exercises need to be colloqued, by which they have duly performed obligations, in addition with prescribed attendance of classes, and they can access the final (written and oral) exam.</p>			
<p>Students' work track <i>(indicate share in ECTS points for each activity so that overall ECTS number</i></p>	<p>Class attendance</p>	<p>2</p>	<p>Research</p>	
	<p>Project</p>		<p>Report</p>	
	<p>Colloquium</p>	<p>0,5</p>	<p>Seminar paper</p>	



<i>corresponds to class credits score):</i>	Practical work		Oral exam	1,5
	Written exam	1,5	(Extra)	
Type of exam, grades and evaluation of students work during class and on final exam	Knowledge is evaluated on the basis of colloquia from exercises, and the final (written and oral) exam.			
Mandatory literature (available in the Library and via other media)	1. Krsnik: Miniranje, RGNF, 1989. 2. Ester: Miniranje I, eksplozivne tvari, svojstva i metode ispitivanja, RGNF 2005			
Additional literature (at the moment of study program proposition application)	1. Krsnik, Ester i dr. :Seminar za palitelje mina, radni materijali, RGN F, 2. Standardi i norme.			
Examination terms	Every Tuesday within exam-terms (at 10 a.m.).			
Other				