BOOK OF COURSES

STUDY PROGRAM:

MINING ENGINEERING

MASTER ACADEMIC STUDIES

(LEVEL II OF ACADEMIC STUDIES)

BOR, 2013.

Content – List of courses

1. PROCESSES MODELING AND OPTIMIZATION

Content

Study program: Mining Engineering				
Level of study: Master Academic Studies				
Course: PROCESSES MODELING AND OPTIMIZATION				
Lecturer: Dr Radoje Pantović, full professor				
Course status: Obligatory course				
ECTS: 8				
Prerequisites: Knowledge of Mathematics and understanding of mining processes				
Course goals: Understanding of the modeling and optimization methods and their application to mining, mineral processing or recycling processes.				
Learning outcome: Individual competencies for decision making and management in mining, mineral processing or recycling related processes.				
Course description: ***Theory****:* Introduction, Formulation of mathematical models. Linear programming. Basic terminology. Convex sets. Limiting set allowed domain. Geometric interpretation of linear programming problem. General shape of linear programming model and its properties. Standard shape of LP model and its general solutions. Simplex method. Duality in LP. Sensibility analysis. Transportation problem. Problem formulation. Closed model of transportation problem. Initial allowed solution. Optimum solution of transportation model. Open model of transportation problem. Prohibited route transportation problem. Activity executors selection. Network planning. Project activities and Gantt chart. Structure analysis. Time analysis. Time and cost analysis ***Practice****:* Practical use of LP and Network planning techniques to solve modeling and optimization problems.				
Literature: **Recommended:** 1. M.Vujošević, M. Stanojević, N. Mladenović, Metode optimizacije, Društvo operacionih istraživača Jugoslavije, Beograd, 1996. 2. S. Krčevinac, M. Čangalović, V. Kovačević-Vujčić, M. Martić, M. Vujošević, Operaciona istraživanja, Fakultet organizacionih nauka, Beograd, 2006. 3. M. Perišić, Linearni modeli optimizacije i odlučivanja u rudarstvu, Rudarski institut, Beograd, 1986				
Number of classes per weak				Other classes
Lectures: 3	Practicals: 3	Other forms of teaching:	Study research work:	
Methods of Teaching: Oral lectures, calculation tasks, discussion.				

Grading system (maximum number of points 100)			
Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	10	Written exam	50
Practicals	10	Oral exam	
Independent work	30		

2. STANDARDS, LEGISLATION AND TECHNICAL DOCUMENTATION IN MINING Content

<table>
<tr><td colspan="5">Study program: Mining Engineering</td></tr>
<tr><td colspan="5">Level of study: Master Academic Studies</td></tr>
<tr><td colspan="5">Course: STANDARDS, LEGISLATION AND TECHNICAL DOCUMENTATION IN MINING</td></tr>
<tr><td colspan="5">Lecturer: Dr Miodrag Žikić, associate professor</td></tr>
<tr><td colspan="5">Course status: Obligatory course</td></tr>
<tr><td colspan="5">ECTS: 6</td></tr>
<tr><td colspan="5">Prerequisites: Completed undergraduate studies</td></tr>
<tr><td colspan="5">Course goals:
To gain basic knowledge on standardization and legislation and to understand the hierarchy of technical documents.</td></tr>
<tr><td colspan="5">Learning outcome:
Competences to apply standards and follow regulations and use technical documentation.</td></tr>
<tr><td colspan="5">Course description:
Theory: Introductory remarks. Historical development of mining related legislation. Overview of mining related legislative acts. Mining and geology act. Construction act. Environmental safety act. Sublegal acts and documents related to mining. Enforcement. Legal sanctions. Form and content of technical documentation. Process of mine design, design review and design application.
Practice: Assignment</td></tr>
<tr><td colspan="5">Literature:
Recommended:
1. Standards catalogues, Legislation almanacs</td></tr>
<tr><td colspan="4">Number of classes per weak</td><td rowspan="2">Other classes</td></tr>
<tr><td>Lectures:
3</td><td>Practicals:
2</td><td>Other forms of teaching:</td><td>Study research work:</td></tr>
<tr><td colspan="5">Methods of Teaching:
Oral lectures, calculation tasks, discussion.</td></tr>
<tr><td colspan="5">Grading system (maximum number of points 100)</td></tr>
<tr><td colspan="2">Pre-examination requirements</td><td>Number of points</td><td>Final examination</td><td>Number of points</td></tr>
<tr><td colspan="2">Attendance and active participation</td><td>55</td><td>Written exam</td><td></td></tr>
<tr><td colspan="2">Independent work</td><td></td><td>Oral exam</td><td>45</td></tr>
<tr><td colspan="2">Practicals</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Preliminary examination</td><td></td><td></td><td></td></tr>
</table>

3. CONSTRUCTION OF SPECIAL UNDERGROUND FACILITIES Content

Study program: Mining Engineering				
Level of study: Master Academic Studies				
Course: CONSTRUCTION OF SPECIAL UNDERGROUND FACILITIES				
Lecturer: Dr Vitomir Milić, full professor; Dr Dejan Petrović, assistant professor				
Course status: Obligatory course				
ECTS: 8				
Prerequisites: Undergraduate studies				
Course goals: Introduction to special underground facilities construction techniques, technological phases and rock behavior**.**				
Learning outcome: Individual competences for special underground facilities design.				
Course description: ***Theory****:* Introductory remarks. Historic development, definitions and classification of underground facilities. Geology conditions and tunneling operations. Dimensioning: Railroad tunnels. Subways. Road tunnels. Hydrotechnical tunnels. Underground chambers. Support calculation. Construction methods: General. Drill and blast tunneling. Mechanized tunneling. Chamber construction methods. Concrete. Underground concrete works and paving. ***Practicals****:* calculation tasks, Support calculation. Scheduling. Equipment selection. Design.				
Literature: **Recommended:** 1. P. Jovanović, Izrada podzemnih prostorija velikog profila, Građevinska knjiga, Beograd, 1984. **Supplementary:** 1. V.Milić, Ž.Milićević, Osnovi eksploatacije ležišta mineralnih sirovina, Tehnički fakultet, Bor				
Number of classes per weak				Other classes
Lectures: 3	Practicals: 3	Other forms of teaching:	Study research work:	
Methods of Teaching: Oral lectures, calculation tasks, discussion				

Grading system (maximum number of points 100)			
Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	5	Written exam	
Practicals	25	Oral exam	70
Preliminary examination			
Independent work			

4. QUARRYING AND STONE PROCESSING

Content

Study program: Mining Engineering				
Level of study: Master Academic Studies				
Course: QUARRYING AND STONE PROCESSING				
Lecturer: Dr Miodrag Žikić, associate professor				
Course status: Elective course				
ECTS: 8				
Prerequisites: Completed course on Mining equipment and machinery				
Course goals: Understanding of quarrying and stone processing technologies.				
Learning outcome: Competencies for individual selection of quarrying technology and basic parameters calculations.				
Course description: ***Theory****:* Introductory remarks. Historical development. Importance, state and trends of quarrying and stone processing. Stone classification. Stone use. Quarrying. Underground stone extraction. Primary and final stone processing. Reclamation and remediation of degraded areas. ***Practice****:* Productivity and capacity calculations. Cost estimation.				
Literature: **Recommended:** 1. M. Maksimović, Eksploatacija, ispitivanje i primena arhitektonskog kamena, Contractor D.O.O., Beograd, 2006. **Supplementary:** 1. Digitalni udžbenik, Eksploatacija arhitektonsko građevinskog kamena, RGN, Zagreb, 2003. 2. V. Popović, Tehnologija površinske eksploatacije, RGF, Beograd, 1992.				
Number of classes per weak				Other classes
Lectures: 2	Practicals: 2	Other forms of teaching:	Study research work:	
Methods of Teaching: Oral lectures, calculation tasks, discussion.				

Grading system (maximum number of points 100)			
Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	55	Written exam	
Practicals		Oral exam	45
Preliminary examination			
Independent work			

5. CONTROLLED BLASTING

Content

Study program: Mining Engineering				
Level of study: Master Academic Studies				
Course: CONTROLLED BLASTING				
Lecturer: Dr Saša Stojadinović, assistant professor				
Course status: Elective course				
ECTS: 8				
Prerequisites: Completed course on Drilling and blasting				
Course goals: Understanding of blasting adverse effects control techniques.				
Learning outcome: Competences for individual conduct of controlled blasts.				
Course description: ***Theory****:* Economic, technical and safety factors of controlled blasting techniques application. Methods of controlled blasting. Line drilling. Buffer and cushion blasting. Smooth blasting. Presplitting. Fragmentation control. Seismic signature method for ground vibration intensity prediction and control. Architectural stone blasting. Demolition. Demolition techniques. Charge weight calculation for concrete structures demolition. Cumulative charge application for steel frame structures demolition. Test blasts. Airblast, ground vibrations and flyrock mitigation measures. Underwater blasts. Seismic exploration blasts. Deep blasthole blasting. Metal forming. ***Practice****:* Controlled blasting parameters calculations. Safety zones definitions.				
Literature: **Recommended:** 1. G. Berta, Exsplosives:An engineering tool, Italesplosivi, Milano, 1990. 2. S. Olofson, Applieed exsplosives technology for construction and mining, Arla, Sweden, 1988. 3. I. Riđešić, Tehnologija izvođenja minerskih radova u urbanim sredinama, Beograd, 1992. **Supplementary:** 1. L. Kričak, Seizmika miniranja, RGF, Beograd, 2005. 2. C. H. Dowding, Construction Vibrations, 2000.				
Number of classes per weak				Other classes
Lectures: 2	Practicals: 2	Other forms of teaching:	Study research work:	
Methods of Teaching: Oral lectures, math calculation tasks, discussion.				

Grading system (maximum number of points 100)			
Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	10	Written exam	
Practicals	10	Oral exam	50
Independent work	30		

6. THEORETICAL PRINCIPLES OF FLOTATION CONCENTRATION Content

Study program: Mining Engineering

Level of study: Master Academic Studies

Course: THEORETICAL PRINCIPLES OF FLOTATION CONCENTRATION

Lecturer: Dr Maja Trumić, assistant professor

Course status: Obligatory course

ECTS: 8

Prerequisites: Completed course on Flotation

Course goals:
Introducing students with theoretical and fundamental principles on which flotation concentration is based

Learning outcome:
Students have theoretical and practical knowledge and are trained to work in educational and scientific research institutions as well as in flotation concentration plants

Course description:
Theoretical teaching*:* INTRODUCTION (phenomena in the flotation system, definitions and terminology) PULP PHASE (solid phase: mineral crystalline structure and types of bonding in crystal lattice, crystal defect, hydrophobic and hydrophilic solid surfaces, liquid phase: physical and chemical water properties, chemical composition of natural waters, gaseous phase: air and gases used in flotation - SO_2 and N, and their physical and chemical characteristics), PHASE BOUNDARY - INTERFACE (phenomenon on phase boundary, electrokinetic potential, electrode potential, dual electric layer, hydration and hydrolysis, ion exchange), FLOTATION REAGENTS (adsorption of surfactants at the three-phase wetting interface)
Practicals*:* Laboratory and computational practicals according to the course of theoretical teaching.

Literature
Recommended:
1. M. M. Gifing, Faze flotacijske pulpe, RGF, Beograd, 1986.
2. S. Milošević, Flotacijska koncentracija, TF, Bor, 1995.
3. J.Solyom, Fundamentals of the Physics of Solids. Springer, 2009. ISBN 978-3-540-85315-2.

Supplementary:
1. A.W.Adamson, Physical Chemistry of Surfaces, John Wiley&Sons, Inc., 1997, ISBN 0-471-14873-3-3h.
2. H. Ibach, Physics of Surfaces and Interfaces, Springer, 2006. ISBN-10 3-540-34709-7.

Number of classes per week				Other classes:
Lectures: 3	Practicals: 2	Other forms of teaching:	Study research work:	

Methods of teaching:
Lectures with interactive work with students, practical work through laboratory and calculation tasks. Pre-examination of knowledge through two preliminary examinations.

Grading system (max. number of points 100)

Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	20	Written exam	20
Practicals	20	Oral exam	20
Preliminary examination 1	10		
Preliminary examination 2	10		

7. MINERAL PROCESSING DESIGN

Content

Study program: Mining Engineering

Level of study: Master Academic Studies

Course: MINERAL PROCESSING DESIGN

Lecturer: Dr Milan Trumić, full professor

Course status: Elective course

ECTS: 8

Prerequisites: Acquired knowledge in the field of comminution and classification of materials, flotation and physical methods of concentration

Course goals:
Introducing students with basic principles of technical documentation preparation and design and equipment selection in plants for the mineral processing

Learning outcome:
Acquiring basic knowledge in the field of design and preparing technical documentation

Course description:
Theoretical teaching*:* Introduction to the design of technological processes and plants. Technical documentation preparation: basic concepts and terminology, administrative and technical conditions. Documentation collection for design (collecting the data about technical characteristics of the device for equipment selection, and for the equipment supply and construction works). Defining a project task. Analysis of all phases that are an integral part of the design project of the basic technological process for the mineral raw materials concentration. Equipment selection from the catalog and preparation of technological data and substrates for other designs (mechanical, electrical, construction).
Practicals*:* Production of reports in the form of a technological project of the plant. Demonstration Practicals with examples of project design for different plants in mineral processing.

Literature

Recommended:

1. M. Trumić, I. Budić, M. Trumić, Osnovi projektovanja u PMS-u, autorizovana predavanja, Tehnički fakultet, Bor, 2008.
2. D. Salatić, D. Knežević, Tehnološke osnove projektovanja postrojenja za PMS, Rudarski institut, Beograd, 1996.
3. M. Grbović, N. Magdalinović, Procesna oprema drobljenja i mlevenja mineralnih sirovina, TF, Bor, IB, Bor, RI, Beograd, 1980.

Supplementary:

1. B. Kolonja, D. Knežević, Transport u PMS-u, RGF, Beograd, 2000.
2. N. Magdalinović, M. Magdalinović-Kalinović, Upravljanje prirodnim resursima, Inorog, Bor, 2007.
3. Mineral Processing Handbook 7/07, Telsmith, Inc., USA, 2007.

Number of classes per week				Other classes
Lectures: 1	Practicals: 2	Other forms of teaching: 1	Study research work:	

Methods of teaching:
Lectures with interactive work with students and practicals in the form of demonstration. Practicals with the active participation of students and elaboration of the reports.

Grading system (max. number of points 100)

Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	10	Written exam	20
Practicals	20	Oral exam	20
Preliminary examination			
Elaboration of the report	30		

8. SPECIFIC METHODS OF FLOTATION

Content

Study program: Mining Engineering
Level of study: Master Academic Studies
Course: SPECIFIC METHODS OF FLOTATION
Lecturer: Dr Zoran Štirbanović, assistant professor
Course status: Elective course
ECTS: 8
Prerequisites: Completed course on Flotation.
Course goals: Introducing students to theoretical and practical principles of application of flotation processes in the field of activity outside mineral technologies
Learning outcome: Theoretical and practical training of students for work in educational and scientific research institutions and industrial organizations.
Course description: ***Theoretical lectures:*** INTRODUCTION (Flotation concentration as a method for separating phases in the system solid-liquid and liquid-liquid); SPECIFIC FLOTATION METHODS (ionic flotation, flock flotation, flotation of colloids, electro flotation, vacuum flotation, flotation with dissolved and dispersed air); APPLICATION (purification of wastewaters from various technological processes that carry dispersed solid particles and droplets - fine to colloidal proportions, economic and ecological significance of these applications). ***Practicals***: Practical lectures are conducted in laboratories in the form of experimental and computational Practicals, according to the program of theoretical lectures.
Literature **Supplementary**: 1. S. Gaćeša i M. Klašnja, Tehnologija vode i otpadnih voda, Beograd, 1994 2. J. Rubio, M.L. Souza, R.W. Smith, Overview of flotation as a wastewater treatment technique, Minerals Engineering, 15, 139–155 2002.

Number of classes per week				Other classes
Lectures: 1	Practicals: 2	Other forms of teaching: 1	Study research work:	

Methods of teaching: Lectures with interactive work with students, practical work through laboratory and calculation tasks. Pre-examination of knowledge through two preliminary examinations.

Grading system (max. number of points 100)			
Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	25	Written exam	
Practicals	25	Oral exam	40
Preliminary examination	10		

9. LANDFILL DESIGN

Content

Study program: Mining Engineering
Level of study: Master Academic Studies
Course: LANDFILL DESIGN
Lecturer: Dr Miodrag Žikić, associate professor; Dr Jovica M. Sokolović, associate professor
Course status: Elective course
ECTS: 8
Prerequisites: Completed undergraduate studies
Course goals: Introducing students to a complete process of designing landfills (mining and communal) from the starting materials to the development of a written project and its technical control.
Learning outcome: Ability of the student to independently develop landfill (mine and communal) projects and to perform their technical control.
Course description: ***Theory*:** Introductory remarks. Historical development, significance, condition and trends in landfill design. Types of landfills and their characteristics. Procedure for the development of mining projects. Standards, laws and other regulations regarding the design of landfills. Bases for design of landfills. The structure of the landfill project. Elaboration of the elements that make up the structure of the landfill project. Specificities relating to mines landfill. Specificities relating to municipal landfills. Basic technical characteristics of the mechanization used in the construction of landfills. Standards used and analyzed during the design of landfills. Overview of recultivation of landfills. ***Practicals*:** Visit of accredited organizations for designing mines and municipal landfills. Practicals. Creation of a demonstration project of landfills within which the student needs to get to know the complete procedure of designing, or technical control of projects.
Literature **Recommended:** 1. A. Lazić, Projecting of surface mines (in Serbian), RGF, Belgrade, 1998. 2. B. Popović, Technology of surface exploitation (in Serbian), RGF, Belgrade, 1992. 3. B. Pavlović, Systems of surface exploitation (in Serbian), RGF, Belgrade, 1998. **Supplementary:** 1. Standards, laws and other normative acts (in Serbian). 2. D. Knežević, Disposal of industrial waste (in Serbian), Authorized lectures, RGF, Belgrade, 2008. 3. N. Popović, Scientific basics of surface mine design (in Serbian), NIRO Community, Sarajevo, 1984. 4. B. Pavlović, Reconstruction of surface mines and landfills (in Serbian), RGF, Belgrade, 2000.

Number of classes per week				Other classes
Lectures: 2	Practicals: 0	Other forms of teaching: 2	Study research work:	

Methods of teaching: Lectures, Practicals, a demonstration project.

Grading system (max. number of points 100)			
Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	15	Written exam	
Practicals	15	Oral exam	40
Independent work	30		

10. HAZARDOUS WASTE MANAGEMENT

Content

Study program: Mining Engineering
Level of study: Master Academic Studies
Course: HAZARDOUS WASTE MANAGEMENT
Lecturer: Dr Grozdanka Bogdanović, full professor
Course status: Elective course
ECTS: 8
Prerequisites: Required knowledge on solid waste management
Course goals: Introducing students to integrated hazardous waste management system
Learning outcome: Acquiring basic knowledge in the field of waste management; theoretical and practical training of students for work in scientific, educational, state and economic organizations dealing with this issue
Course description: ***Theoretical instruction****:* Introduction: Definition of hazardous waste. Hazardous Waste Management Strategy. Classification of hazardous waste: types of waste and characterization. Sources, types and characteristics of hazardous waste that can be found in municipal solid waste. Persistent organic pollutants in hazardous waste. Polychlorinated biphenyls, dioxins and furans. Medical waste. Assessment of health risks from hazardous waste. Collection of hazardous waste and on-site storage. Transfer and transport of hazardous waste. Hazardous waste treatment technologies: Biological treatment; Chemical treatment; Physical-chemical treatment; Incineration; Pyrolysis; Stabilization / Solidification; Remediation. Recycling of hazardous waste. Disposal of hazardous waste. Toxicology of some hazardous and harmful substances. Legislation in the field of hazardous waste management. ***Practical instruction****:* Demonstration Practicals for the process of processing certain types of hazardous waste.
Literature **Recommended**: 1. B. Škrbić, Polihlorovani bifenili, Tehnološki fakultet, Novi Sad, 2003. **Supplementary**: 1. B. Jakšić, M. Ilić, Upravljanje opasnim otpadom, Urbanistički zavod Republike Srpske, Banja Luka, 2000. 2. B. Jakšić, M. Ilić, Milorad Balaban, Upravljanje medicinskim otpadom, Urbanistički zavod Republike Srpske, Banja Luka, 2001. 3. J. Lippit, P.Webb, W. Martin, Hazardous Waste Handbook, Third Edition, Elsevier Butterworth – Heineman, 2000.

Number of classes per week				Other classes
Lectures: 2	Practicals: 0	Other forms of teaching: 2	Study research work:	

Methods of teaching: Lectures, practicals and seminar paper.

Grading system (max. number of points 100)			
Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	10	Written exam	
Practicals		Oral exam	40
Preliminary examination	10		
Independent work	40		

11. GEOINFORMATICS AND GEODATA BASE

Content

Study program: Mining Engineering
Level of study: Master Academic Studies
Course: GEOINFORMATICS AND GEODATA BASE
Lecturer: Dr Nenad Vušović, full proffesor
Course status: Elective course
ECTS: 8
Prerequisites: Previously acquired knowledge in the course on Geodesy and Geoinformation Technology
Course goals:
Learning outcome: The acquired knowledge is the basis for studying the course Design of Geoinformation Systems (GIS)
Course description: Geoinformatics-terminology, definition, historical development. Spatial data and geoinformation. Maps and computer cartography. Spatial Data Infrastructure-SDI. Elements of Geospatial Data Infrastructure. NIGP - National Geospatial Data Infrastructure. INSPIRE - European Infrastructure for Spatial Information. INSPIRE Directive. Spatial data interoperability. Spatial data sets. Spatial data services (geoportals). Network services and technologies. Agreements on sharing, access and use. Modeling the real world. Spatial data models. Conceptual Spatial Data Model (entities and continuous fields). Computer Spatial Data Model. Vector and raster data. Raster data model. Vector data model. Vectorization on a computer. Digitalization of graphic substrates. Georeferencing of vector and raster data. Representation of spatial entities. Geometric Primitives for Spatial Data (Point, Line, Polygon). Topology and topological primitives (node, edge, appearance). Geometric and topological consistency. Thematic data. Standardization of geopaths. Spatial Databases-Geobases: Hierarchical Behavioral Data Structure. Network structure of the database. Relational database structure. Object-oriented database structure. Database Management Systems-DBMS. Spatial databases-geobases. Organization of data in raster structures. Methods for raster data storage. Organization of data in vector structures. Spaghetti models. NAA model and DCEL model for vector data. Vector data structures for special purposes-TIN. Saving vector and raster data structures in the geobase of data. Spatial data models based on fields. Realization of spatial databases. Time aspects of spatial data. Object-oriented GIS databases. Automatic data analysis. Automatic fault detection. Flexible inquiries. Calculations with geospatial data. ***Practicals***: computer Practicals in GIS software and seminar paper.
Literature: **Recommended:** 1. P. Burrough, A. McDonnell, Principles of Geographic Information Systems, 2006. **Supplementary:** 1. N.Vušović, Data base, University at Belgrade-Technical facultu in Bor, Bor 2009. 2. D. Mihauilović, Basics of Geoinformatics, Faculty of Civil Engineering, Belgrade, 2006. 3. ESRI training and education http://training.esri.com/

Number of classes per week				Other classes
Lectures: 3	Practicals: 3	Other forms of teaching:	Study research work:	

Methods of teaching: ESRI training.

Grading system (max. number of points 100)

Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	5	Written exam	20
Practicals	5	Oral exam	50
Independent work	20		

12. SANATION AND RECULTIVATION OF LAND

Content

Study program: Mining Engineering				
Level of study: Master Academic Studies				
Назив предмета: SANATION AND RECULTIVATION OF LAND				
Lecturer: Dr Miodrag Žikić, associate professor; Dr Jovica M. Sokolović, associate professor				
Course status: Elective course				
ECTS: 8				
Prerequisites: Acquired knowledge in the course on Landfill design.				
Course goals: Introducing students to the processes of sanation and land recultivation, choosing the best way of recultivation and the necessary measures of protection and land recultivation.				
Learning outcome: Training students to decide in a decisive manner on the processes of rehabilitation and land reclamation that have previously been degraded by mining or other activities.				
Course description: ***Theory*:** Introductory remarks. Land degradation, Condition and trends. Types and characteristics of degraded land. Standards and legal regulations related to land reclamation and reclamation. Land remediation procedures. Land reclamation procedures. Technical recultivation. Basic principles of technical recultivation. Research of initial parameters for technical recultivation. Stability and design of slopes. Phases in the process of technical recultivation. Technological procedures for technical land reclamation. Biological recultivation. Purpose of the surface. Baseline parameters for biological recultivation. Basic characteristics of the substrate. The procedure for performing biological recultivation of degraded land. Selection of cultures in relation to the natural and economic conditions of the environment. Dynamics of the performance of certain phases of biological recultivation. Care measures and plant protection. Machines, appliances and other equipment used for land reclamation and recultivation. Techno-economic assessment of land reclamation and recultivation. ***Practical*:** Laboratory testing of degraded soil quality, preparation of independent work with processing of practical problem of sanation and recultivation of degraded land. Field Practicals. Tour of land-terrain which has been degraded, rehabilitated and recultivated.				
Literature **Recommended:** 1. M. Miljković, M. Žikić, J. Sokolović, Sanation and recultivation of land (in Serbian), Authorized lectures, Technical Faculty in Bor, Bor, 2009. 2. B. Pavlović, Reconstruction of surface mines and landfills (in Serbian), RGF, Belgrade, 2000. 3 M. Oljača, D. Raičević, Mechanization in soil melioration (in Serbian), Faculty of Agriculture, Belgrade, 1999. 4. D. Dražić, Multifunctional valorisation of landscapes and ecosystems created by recultivation land of mining dumps (in Serbian), Kolubara Basin, 1998. **Auxiliary:** 1. Standards, laws and other normative acts (in Serbian). 2. Project for recultivation of land areas degraded by mining of exploitation and disposal of mining waste and flotation tailing disposal (in Serbian), RBM, 2008.				
Number of classes per week				Other classes
Lectures: 3	Practicals: 3	Other forms of teaching:	Study research work:	
Methods of teaching: Lectures, Practicals, practical lessons, independent work.				
Grading system (max. number of points 100)				
Pre-examination requirements		**Number of points**	**Final examination**	**Number of points**
Attendance and active participation		15	Written exam	
Practicals		15	Oral exam	40
Independent work		30		

13. PROCESS CONTROL IN MINERAL AND RECYCLING TECHNOLOGIES Content

Study program: Mining Engineering
Level of study: Master Academic Studies
Course: PROCESS CONTROL IN MINERAL AND RECYCLING TECHNOLOGIES
Lecturer: Dr Vladimir Despotović, assistant professor
Course status: Elective course
ECTS: 8
Prerequisites: no prerequisites
Course goals: Learning fundamentals of process dynamics and control theory. Application of numerical methods and modern software tools in industrial process control.
Learning outcome: The course prepares students to apply numerical methods, devices and software tools for automatic control of technological processes in industry.
Course description: ***Lectures****:* Principles of automatic control. Types of control systems. Mathematical methods for modeling of process control systems. Linear and nonlinear models. Static and dynamic systems. Laplace transform. Dynamic models in time and frequency domain. Transfer function. Block diagrams. Open and closed loop. State-space representation of linear systems. Stability of linear systems. Algebraic and graphical stability criteria. Computer-aided process control. Centralized vs. distributed process control. Supervisory control and data acquisition (SCADA). ***Practicals****:* Computer-aided laboratory Practicals.
Literature: **Recommended:** 1. D. Ivezić, D. Debeljković, M. Rančić, Automatization and process control (in Serbian: Automatizacija i kontrola procesa), Faculty of Mining and Geology, University of Belgrade, Belgrade, 2006. 2. M. R. Stojić, Automatic control systems (in Serbian: Sistemi automatskog upravljanja), Faculty of Electronic Engineering, University of Niš, 2004. **Supplementary:** 1. E.A. Parr, Programmable Controllers (an engineer's guide), Third edition, Linacre House, Jordan Hill, Oxford, 2003. 2. M. Strak, M. Jevtić, Computer-aided Practicals in fundamentals of automatic process control (in Serbian: Praktikum iz računarskih vežbi iz osnova automatizacije), Technical Faculty in Bor, University of Belgrade, Bor, 2002.

Number of classes per week				Other classes
Lectures: 3	Practicals: 3	Other forms of teaching:	Study research work:	

Methods of teaching
Lectures and laboratory Practicals.

Grading system (max. number of points 100)

Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	10	Written exam	40
Practicals		Oral exam	30
Preliminary examination	20		
Independent work			

14. STUDY RESEARCH WORK ON THEORETICAL BASIS OF THE MASTER THESIS

Content

Study program: Mining Engineering				
Level of study: Master Academic Studies				
Course: STUDY RESEARCH WORK ON THEORETICAL BASIS OF THE MASTER THESIS				
Lecturer: Dr Milan Trumić, full professor				
Course status: Obligatory course				
ECTS: 6				
Prerequisites: Acquired knowledge through obligatory and elective courses of the curriculum				
Course goals: Acquiring knowledge for identifying and analyzing problems, finding solutions, presenting research results in the form of work and public presentation				
Learning outcome: Students are trained to independently identify problems, search literature, make conclusions and presentations				
Course description: ***Theoretical teaching****:* Getting acquainted with libraries and databases that contain scientific literature. Access and methods of searching library literature and literature on the Internet. Literature processing and citation literature. Processing of survey results using software packages for diagram processing, tables and images. Structure of master work. Methods for preparing a public presentation of the master's work. ***Practicals-Practicals****:* Accessing and searching databases with specific examples. Processing concrete research results using software packages. Preparing the presentation.				
Literature **Recommended**: 1. M. Vuković, Ž. Živković, Metodologija naučno istraživačkog rada, Grafožig, Beograd, 2005. **Supplementary**: 1. Databases of scientific journals on the Internet.				
Number of classes per week				Other classes
Lectures: 2	Practicals: 2	Other forms of teaching: 0	Study research work:	
Methods of teaching: Theoretical lectures are conducted with lectures and practical in the form of demonstration, practicals with the active participation of students and elaboration of the reports.				

Grading system (max. number of points 100)			
Pre-examination requirements	**Number of points**	**Final examination**	**Number of points**
Attendance and active participation	10	Written exam	
Practicals	20	Oral exam	40
Preliminary examination			
Elaboration of the report	30		

15. PROFESSIONAL PRACTICE

Content

Study program: Mining Engineering	
Level of study: Master Academic Studies	
Course: PROFESSIONAL PRACTICE	
Lecturer: All lecturers on study program	
Course status: Obligatory course	
ECTS: 6	
Prerequisites: Enrolled II semester	
Course goals: The aim of the professional practice of Master Academic Studies is to introduce students to detailed phases of the production process in accordance to the elective module. This involves a detailed introduction to the workings of an industrial process, verification of individual stages of process, analysis of technical and technological indicators of the process and presentation of results in written form. The primary goal of the professional practice is to directly engage students in learning and controlling certain stages of the process, performing experiments, displaying and analyzing results as well as presenting them in written form, with the aim of training for independent master work.	
Learning outcome: Training students for the practical application of previously acquired theoretical knowledge at solving specific industrial problems in a company where professional practice is conducted, as well as in similar companies. In addition to practical knowledge, students gain experience in presentation, analysis of obtained results, finding solutions and giving conclusions. The final outcome of the professional practice of Master Academic Studies is to train students for future independent master work.	
Course description: The content of the professional practice is different for the students of individual modules of the study program Mining Engineering. Due to the specificity of the mining industrial processes, the contents of the professional practice are defined for smaller groups of students or for each student individually. The professional practice program for students is created by the lecturer-coordinator of professional practice, in consultation with the lecturers of the appropriate module of the study program Mining Engineering and the specifics of the technological process of the company in which the professional practice is carried out.	
Number of classes per week	Other classes: 10
Methods of teaching: The method of carrying out professional practice implies practical work in the industrial production process, verification of a certain stage of the process, laboratory tests on samples of raw materials, presentation of the obtained results, as well as analysis and commentary on them. Upon completion of the professional practice, the student hands over to the lecturer-coordinator three copies of the written study of the professional practice, in which all the results of the research are presented. The lecturer-coordinator of professional practice examines the written study of the professional practice and, with his signature in the Student assessment booklet, confirms that the student has successfully completed the same, which enables the student to verify the second semester of Master Academic Studies.	
Grading system (max. number of points 100)	
Presence on professional practice:	50
Defense of professional practice:	50

16. MASTER THESIS

Content

Study program: Mining Engineering
Level of study: Master Academic Studies
Course: MASTER THESIS
Lecturer: All professors on study program are potential mentors
Course status: Obligatory course
ECTS: 10
Prerequisites: All exams passed on the study program Mining Engineering at master academic studies and completed professional practice
Course goals: The aim of the thesis is that the student independently reviewing theoretical, experimental research and analysis of results, solve some practical problem. Through the presentation of master thesis and public defense, the student show the ability to apply theoretical knowledge and practical skills in future engineering practice. In order to best evaluate the experience gained in the master's thesis, it is recommended that the theme be in line with the company's activity in which the future engineer will start a professional career.
Learning outcome: By the independent creation of the research program, students are able to realistically examine the problems of particular phases of the technological process and solve problems in an appropriate way. In addition to training students for independent management, control and regulation of the technological process, students are also trained to continue their studies at doctoral studies. Competencies acquired in this way are expressed by the ability of critical thinking, analysis, synthesis and making reliable decisions in real time.
Course description: The content of master thesis is different for each student separately, in accordance with the specifics of all three modules of the study program Mining Engineering. Master thesis, represents the research work of the student in narrow scientific-professional fields, exploitation of mineral raw materials deposits, mineral processing and recycling technologies and sustainable development. The results of the research envisaged by the master program are presented in the following form: introduction, theoretical part, experimental part, research results and discussion, conclusion and literature review. Master thesis done in the form of the study report, the student is handed over to the Faculty in three copies, after which the public defense of the same is conducted in front of a three-member commission formed by the professors of this study program or module.
Methods of teaching: The mentor for research, writing and defending bachelor thesis is selected according to the topic on the appropriate module. The formulation of the master's thesis is carried out by a mentor in accordance with the interests of the company if the student is a scholarship holder or a student's suggestion if there are prospects of employing it in certain companies or institutions. The student, in consultation with the mentor, independently creates a research program aimed at solving the given task. Upon completion of the master's thesis and the approval of the mentor, the student defends master thesis in front of a three-member commission of professors. The condition for defending the master thesis is passed all exams of the appropriate module and realized professional practice from the curriculum of the study program.

Grading system (max. number of points 100)	
Research, writing master thesis	50
Presentation and defense of master thesis	50