	University of Belgrade **Technical faculty in Bor**	
	ACCREDITATION OF THE STUDY PROGRAMME	
	UNDERGRADUATE ACADEMIC STUDIES	**METALLURGICAL ENGINEERING**

BOOK OF COURSES

STUDY PROGRAM:
METALLURGICALENGINEERING

Undergraduate Academic Studies

(1st level of the Academic Studies)

Bor, 2023.

Study programs: Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: MATHEMATICS 1

Lecturer: PhD Ivana M. Stanišev, assistant professor

Status of the course: Elective for Engineering Management, Compulsory for Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 8

Prerequisite: Basic high school knowledge in mathematics.

Course goals: Application of acquired knowledge in the field of content items.

Learning outcomes: Through the course students should be able to use matrix calculus (determinants) for solving systems of linear equations, solve the problems of minimum and maximum, learn the basic notions of functions of one or two variables and apply that knowledge in the upcoming mathematical courses as well as courses for which we need mathematical tools.

Course description:

Lectures:

Introduction: basic notions (sets, relations, algebraic structures, sets of numbers). Matrices (definitions, equality of matrices, addition and multiplication of matrices). Determinants; Matrix inverse. Rank of a matrix. Systems of linear equations (solving the system using Gaussian method of elimination, Cramer's rule and Kronecker-Capelli theorem). Real functions of a real variable (basic notions). Limits of functions; Continuity of functions. Derivative of a function; Differential of a function. Theorems about differentiation; L'Hopital's rule; Taylor's formula. Intervals of monotonicity of a function and local extremums of a function. Intervals of convexity and inflection points. Drawing the graph of a function. Functions of two variables; partial derivatives. Local extremums of functions of two variables.

Practice: Calculation exercises

Literature:

Recommended:

1. M. Janić, Matematika (I i II), TF Bor, 2003.
2. M. Janić, Zbirka rešenih zadataka iz Matematike (I i II), TF Bor, 1996.
3. M. Uščumlić, P. Miličić, Zbirka zadataka iz više matematike I, Nauka Beograd, 1996.
4. S. Vukadinović, D. Sučević, Z. Šami, Matematika II sa zbirkom zadataka, Saobraćajni fakultet, Beograd, 2003.

Ancillary:

1. B.P. Demidovič, Sbornik zadač i upražnenii po matematičeskomu analizu, Nauka, Moskva, 1997.

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

Teaching methods

Theoretical teaching of the frontal type, group, and individual work.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	20	Written part of the final exam	40
Exercise attendance		Oral part of the final exam	
Coloquium exam/s	40		
Term paper			

Study program: Technological Engineering, Mining Engineering, Metallurgical Engineering,

Course: PHYSICS

Lecturer: PhD Čedomir A. Maluckov, full professor

Status of the course: Compulsory for Technological Engineering, Mining Engineering and Metallurgical Engineering

ECTS: 8

Prerequisite: High school knowledge of physics.

Course goals: Acquisition of basic knowledge about physical phenomena and connections between physical quantities.

Learning outcomes: Acquaintance with the basic laws of physics, with the aim of successfully following classes at the higher years of study.

Course description:

Lectures:

International System of Units. MECHANICS. Straight and circular movement. Newton's laws of dynamics and defining the basic concepts of dynamics. Laws of posture. Basic concepts of statics. Newton's law of gravity. Elastic deformations. Oscillatory motion. Mechanical waves (polarization, interference and diffraction of waves). Fluid mechanics. HEAT AND TEMPERATURE. Expansion of the body during heating. Gas laws. The first and second laws of thermodynamics. Thermodynamic processes. Change of aggregate states. Real gases and critical temperatures. Transfer and passing of heat. ELECTROMAGNETICS. Coulomb's law. Force work in an electric field. Direct currents. Ohm's law. Kirchhoff's rules. Magnetic field. Magnetic induction. Electric oscillations and electromagnetic waves. Alternating current. OPTICS. Photometry. Geometric optics. Thin lenses. Wave optics (interference, diffraction and polarization of light). Photoelectric effect. ATOMIC AND NUCLEAR PHYSICS. Rutherford-Bohr model of the atom. The Rydberg constant and the interpretation of atomic spectra. X-ray radiation. Sommerfeld's theory of elliptic trajectories. Spatial quantization. Electron spin. Quantum numbers and the Pauli principle. Radioactive radiation. Law of radioactive decay. Radioactive arrays. Nuclear reactions. Proton-neutron hypothesis of the atomic nucleus. Dimension and bond energy of the nucleus. Nuclear forces. Elementary particles. Classification of elementary particles.

Practice:

Computational and laboratory exercises follow the lectures.

Literature:

Recommended:

1. H.D. Young, R. A. Freedman, A. L. Ford, Sears and Zemanskys University Physics, with Moder Physics, 13th edition, Addison Wesley, 2012.
2. Debora M. Katz, Physics for Scientists and Engineers: Foundations and Connections, Extended Version, Cengage Learning, 2016.

Ancillary:

1. I.E Irodov, Problems in General Physics, Mir Publishers, Moscow, 1981.

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

Teaching methods

Classic lectures with interactive discussions, computational and laboratory exercises, consultations and colloquia.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	20
Exercise attendance	10	Oral part of the final exam	20
Coloquium exam/s	40		
Term paper			

Study program: Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: GENERAL CHEMISTRY

Lecturer: PhD Ana A. Radojević, assistant professor

Status of the course: Compulsory for Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 8

Prerequisite: High school chemistry knowledge.

Course goals: The course is designed to provide a basic knowledge in the field of general chemistry and set a foundation for understanding other subjects related to chemistry and chemical technology.

Learning outcomes: Mastering and understanding the basic terminology and laws in the field of chemistry. Mastering chemical calculations and basic laboratory techniques with the aim of easier understanding the material covered in subsequent specialized courses.

Course description:

Lectures:

Chemical laws. Mol. Chemical reactions and stoichiometry. Periodic table of elements. Structure of atoms. Bohr atomic model. Wave-mechanical model of atom. Ionization energy, electron affinity and electronegativity. Chemical bonding. Covalent bonding. Complex compounds. Ionic bonding. Metallic bonding. Hybridization. Molecular orbitals. Characteristics of state of matter. Gases. Solutions. Amorphous and crystalline substances. Types of chemical reactions. Thermochemistry. Chemical thermodynamics. Chemical equilibrium. Chemical kinetics. Acid-base reactions. Sedimentation reactions. Redox reactions. Oxidation number. Electrode potential. Complexation reactions. Electrolytic dissociation. Ionic reactions. The main classes of inorganic compounds.

Practice:

Laboratory and calculus classes covering the basic chemical laws. Calculations based on the chemical formulas and chemical equations (stoichiometry). Gas laws. Types of chemical reactions. Experimental techniques for separation and purification methods of substances. Solutions. Electrolytic dissociation and ionic reactions. The ionic product of water. Chemical kinetics. Properties of dilute solutions. Chemical equilibrium in homogeneous and heterogeneous systems. Hydrolysis. Energy changes during chemical reactions.

Literature:

Recommended:

1. M. Dragojević, M. Popović, S. Stević, V. Šćepanović, Opšta hemija (I deo), Tehnološko- metalurški fakultet, Beograd, 2007.
2. M. Popović, D. Vasović, Lj. Bogunović, D. Poleti, O. Ćuković, Zbirka zadataka iz opšte hemije, Tehnološko-metalurški fakultet, Beograd, 2007.
3. S. Grujić, A. Hadži-Tonić, S. Jevtić, M. Nikolić, J. Rogan, Opšta hemija I – praktikum, Tehnološko-metalurški fakultet, Beograd, 2007.
4. A. Radojević, J. Milosavljević, Praktikum iz Opšte hemije, Tehnički fakultet u Boru, Bor, 2022.

Ancillary:

1. D. Poleti, N. Rajić, Opšta hemija I – priručnik, Tehnološko-metalurški fakultet, Beograd, 2007.
2. S.R. Arsenijević, Opšta i neorganska hemija, Partenon, Beograd, 2001.
3. Lj. Bogunović, O. Leko, M. Popovič, S. Stevič, O. Ćuković, J. Šašić, D. Poleti, Zbirka zadataka iz Opšte hemije, Tehnološko-metalurški fakultet, Beograd, 1985.

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

Teaching methods

Classical lectures with interactive discussions, calculus and practical classes, consultations and colloquia.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	60
Exercise attendance	15	Oral part of the final exam	
Colloquium exam/s	20		
Term paper			

Study program: Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: INFORMATICS 1

Lecturer: PhD Milena M. Gajić, assistant professor

Status of the course: Compulsory for the Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 4

Prerequisite: The basic informatics knowledge from the high school.

Course goals: Acquiring basic computer knowledge in information technology.

Learning outcomes: Introduce with the operation of computer systems and their application for data processing basic level.

Course description:

Lectures:

Numeral systems and number translation: The essence of numeral system, the translation of numbers from one numeral system to another, the conversion from binary to octal and hexadecimal numeral systems, binary arithmetic, basic arithmetic operations in the system with an arbitrary basis.

Representation of data in computer: BCD data, one's complement, two's complement, complement arithmetic, ASCII codes.

Boolean and switching algebra: definition of Boolean algebra and basic examples, idempotence law, the law of involution operation of negation, De Morgan's theorem, the law of absorption, the simplification of logic expressions, minimization of logical expressions, Karnaugh maps, switching algebra, analysis and synthesis logic circuits.

Switching and logic gates: Switching gates, AND, OR and NOT logic gates, examples of logic gates, analysis and synthesis of switching gates.

Practice:

During the exercises, students do tasks in the field of numerous systems and switching and logic circuits.

Literature:

Recommended:

1. J. Đorđević, Z. Radivojević, M. Punt, Ž. Stanisavljević, Osnovi računarske tehnike. Akademska misao, Beograd, 2017.
2. D. Brodić, M. Jevtić, Zbirka zadataka iz Informatike 1, Tehnički fakultet u Boru, Bor, 2015.

Ancillary:

1. I. Mladenović, Informatika 1, Tehnički fakultet u Boru, Bor. 2008.
2. V. Manojlović, Osnovi računarske tehnike, Prvi deo: Podaci i operacije, Akademska misao, Beograd, 2007.
3. V. Manojlović, Osnovi računarske tehnike, Drugi deo: Digitalna logika, Fakultet tehničkih nauka, Kosovska Mitrovica, 2013.

Number of classes per week	**Lectures: 2**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching:**

Teaching methods

Teaching contains lectures, seminars and exercises, which include work in groups.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	40
Exercise attendance	5	Oral part of the final exam	
Coloquium exam/s	40		
Term paper	10		

Study program: Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: ENGLISH LANGUAGE 1a

Lecturer: Sandra Vasković, Slavica Stevanović

Status of the course: Compulsory for Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 2

Prerequisite: Basic language user.

Course goals: Developing all language skills; the adoption of grammatical structures, vocabulary, and an emphasis on functional English corresponding to the lower intermediate level (CEFR-A2).

Learning outcomes: Students can express themselves in writing and orally using simpler language structures and vocabulary needed for everyday communication. Students can understand less complex texts and are able to find the required information in the texts.

Course description:

Lectures:

Topics: Everyday life, Travelling, Parents and teenagers, Fashion, Psychology, etc.

Grammar: Verb tenses (present simple and continuous, past simple and continuous, be going to, present perfect – yet, just, already, will/won't – predictions, decisions, offers, promises), defining relative clauses, indefinite pronouns, quantifiers, comparison of adjectives and adverbs.

Language functions: Practical English (hotel problems, restaurant problems, in a store...).

Practice:

Determining and practicing the material covered in lectures using all language skills.

Literature:

Recommended:

1. C. Latham-Koenig, C. Oxeden, P. Seligson, English File 3rd edition, Student's Book, OUP, Oxford, 2012.
2. T. Hutchinson, Lifelines, Pre-Intermediate, Student's Book, OUP, Oxford, 2009.
3. Selection of texts from different sources.

Ancillary:

1. S. Stevanović, English Language 1 - Grammar Exercises, Workbook with Key, Technical Faculty in Bor, 2018.
2. R. Murphy, W.R. Smalzer, Basic Grammar in Use, CUP, Cambridge, 2007.
3. Selection of exercises from various sources.

Number of classes per week	**Lectures: 1**	**Practical classes: 1**	**Study research work:**	**Other forms of teaching:**

Teaching methods

Eclectic

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	30
Exercise attendance	5	Oral part of the final exam	40
Coloquium exam/s	20		
Term paper			

Study program: Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: INORGANIC CHEMISTRY

Lecturer: PhD Snežana M. Milić, full professor

Status of the course: Compulsory for Technological Engineering, Mining Engineering (modules PMD and RTSD) and Metallurgical Engineering.

ECTS: 8

Prerequisite: Acquired knowledge of General chemistry.

Course goals: Students acquire basic knowledge of properties of elements, their reactions and compounds.

Learning outcomes: Better understanding of technological courses.

Course description:

Lectures:

General characteristics of elements. Aboundance. Reactivity. Production. Compounds. Application. Chemistry of hydrogen and noble gases. Chemistry of nonmetals and metaloides. Chemistry of metals. *s*- and *p*- elements. Transition metals (*d*- and *f*- elements). Chemical aspects of environmental pollution.

Practice:

Laboratory exercises.

Literature:

Recommended:

1. D. Poleti, Opšta hemija, II deo – hemija elemenata, Tehnološko-metalurški fakultet, Beograd, 2000.
2. N. Nikolić, Osnovi neorganske hemije, Prirodno-matematički fakultet, Niš, 2014.
3. S.R. Arsenijević, Opšta i neorganska hemija, Partenon, Beograd, 2001.
4. S. Milić, Praktikum iz neorganske hemije, Tehnički fakultet u Boru, Bor, 2013.
5. M. Popović, D. Vasović, LJ. Bogunović, D. Poleti, O. Ćuković, Zbirka zadataka iz Opšte hemije, Tehnološko–metalurški fakultet, Beograd, 2003.

Ancillary:

1. N. Rajić, Praktikum neorganske hemije, Tehnološko–metalurški fakultet, Beograd, 2004.
2. LJ. Bogunović i saradnici, Praktikum opšte hemije, II deo, Tehnološko–metalurški fakultet, Beograd, 2004.
3. N.L. Glinka, Zadaci i vežbe iz opšte hemije, Naučna knjiga, Beograd, 1994.

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

Teaching methods

Classical lectures with interactive discussions, calculation and laboratory exercises, consultation and colloquiums.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	60
Exercise attendance	10	Oral part of the final exam	
Colloquium exam/s	20		
Term paper			

Study program: Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: INFORMATICS 2

Lecturer: PhD Dragiša M. Stanujkić, full professor

Status of the course: Compulsory for the Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 6

Prerequisite: The basic informatics knowledge from the high school.

Course goals:
An introduction to the C programming language.

Learning outcomes:
Students will be familiar with advanced methods and techniques of using computers to effectively apply them in a business environment. In addition, students will improve their skills related to the application of Microsoft Access and the C programming language.

Course description:
Lectures:
Software: Software, concept and role in computer system. Types of software.
Databases: Introduction to relational databases, fields, rows, tables, primary keys, foreign keys.
Microsoft Access: Tables, relations, forms, reports.
Introduction to programming and the C programming language: Basic elements of the C programming language: Keywords, identifiers, data types, operators, input and output commands. Basic program structures: if ... else, for, while, break and continue, switch ... case. Complex (nested) program structures. Functions: "built in" functions, user-defined functions. Arrays.
Practice:
Software: Software, concept and role in computer system. Types of software.
Databases: Introduction to relational databases, fields, rows, tables, primary keys, foreign keys.
Microsoft Access: Tables, relations, forms, reports.
Introduction to programming and the C programming language: Basic elements of the C programming language: Keywords, identifiers, data types, operators, input and output commands. Basic program structures: if ... else, for, while, break and continue, switch ... case. Complex (nested) program structures. Functions: "built-in" functions, user-defined functions. Arrays.

Literature:
Recommended:
1. R. Stankić, Poslovna informatika, Ekonomski fakultet, Beograd, 2012.
2. L. Kraus, Programski jezik C sa rešenim zadacima. 9. izdanje, Akademska misao, 2014.
Ancillary:
1. R.W. Sebesta, Concepts of Programming Languages, 10th ed., Addison-Wesley Publishing Company, 2012.

Number of classes per week	**Lectures: 2**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching:**

Teaching methods
Teaching contains lectures, seminars and exercises, which include work in groups.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	40
Exercise attendance	5	Oral part of the final exam	
Coloquium exam/s	40		
Term paper	10		

Study program: Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: ENGINEERING GRAPHICS

Lecturer: PhD Dejan I. Tanikić, full professor

Status of the course: Compulsory for Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 6

Prerequisite: /

Course goals: Obtaining knowledge about the basic geometric shapes, their mutual positions and intersections and their representation in the drawings, using manual sketching and drawing, as well as computer graphics.

Learning outcomes: Students have mastered technical rules, regulations and conventions and can successfully use the most modern tools required for successful communication in the technical field.

Course description:

Lectures:

Introduction to the Engineering Graphics. Modern graphic software. The basics of the projective representation (projection methods; projection planes; orthogonal projection; single and multiple views projections; projection of the point; projection of line; projection of planes; projection of solids; intersection of a plane and a solid; intersection of solids). Drawing geometric objects in three orthogonal projections. Axonometric representation of the geometric objects. Dimensioning and surface roughness marking. Tolerances. Sketching and drawing of the geometric objects. Drawing assemblies and part's details. Using computer to draw and model geometric objects. Saving, plotting and printing drawings. Using various available software packages for drawing.

Practice:

Practicals. Other forms of teaching. Practical use of AutoCAD software package.

Literature:

Recommended:

1. D. Tanikić, S. Kalinović, Inženjerska grafika, Tehnički fakultet u Boru Univerziteta u Beogradu, Bor 2019.
2. R. Gligorić, Nacrtna geometrija – primena, Poljoprivredni fakultet, Novi Sad, 2015.

Ancillary*:*

1. M. Hamad, AutoCAD 2019 Beginning and Intermediate, Mercury Learning & Information, 2018.
2. С. Илић, Основе AUTOCAD-а, Микро књига, 2017.

Number of classes per week	**Lectures: 2**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching:**

Teaching methods

Lectures, practicals, colloquiums.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final examination**	Points
Lecture attendance	20	Written part of the final exam	30
Exercise attendance	10	Oral part of the final exam	
Homework	10		
Colloquium exam/s	15+15		

Study program: Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: MATHEMATICS II

Lecturer: PhD Ivana Z. Đolović, full professor

Status of the course: Compulsory for Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 8

Prerequisite: Fundamental knowledge in Mathematics I.

Course goals: Application of the theoretical knowledge in further work.

Learning outcomes: Students should be able to apply formal mathematical knowledge in recognizing and solving tasks in further studying process as well as real problems in engineering, sciences, business and technology fields.

Course description:

Lectures:

Indefinite integral (definition, substitution rule, integration by parts); Integration of rational and irrational functions; Integration of trigonometric functions; definite integrals; Improper integrals; Application of definite integrals; Differential equations of first order; Separable differential equations of first order; First order homogeneous linear equation; Linear differential equation of first order; Bernoulli differential equation; Lagrange's differential equation; Clairauts' differential equation; Exact differential equation. Differential equations of second order; Reduction of order of differential equation; Second order linear homogeneous differential equations with constant coefficients; Second order linear homogeneous differential equations with variable coefficients; Second order linear nonhomogeneous differential equations with constant coefficients; Second order linear nonhomogeneous differential equations with variable coefficients. Lagrange's method of variation of parameters (constants).

Practice:

Calculation exercises.

Literature:

Recommended:

1. M. Janić, Matematika (I i II), TF Bor, 2003.
2. M. Janić, Zbirka rešenih zadataka iz matematike (1 i 2) TF Bor, 1996.
3. M. Uščumlić, P. Miličić, Zbirka zadataka iz više matematike I, Nauka Beograd, 1996.
4. D. Mitrinović, J. Kečkić, Matematika II, Građevinska knjiga, Beograd, 1991.
5. S. Vukadinović, D. Sučević, Z. Šami, Matematika II sa zbirkom zadataka, Saobraćajni fakultet, Beograd, 2003.

Ancillary:

1. Б.П. Демидович, Сборник задач и упражнении по математическому анализу, Наука, Москва, 1977.

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

Teaching methods

Frontal teaching emphasizing application in the vocational subjects in the coming semesters.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	20	Written part of the final exam	40
Exercise attendance		Oral part of the final exam	
Colloquium exam/s	40		
Term paper			

Study program: Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: ENGLISH LANGUAGE 1b

Lecturer: Sandra Vasković, Slavica Stevanović

Status of the course: Compulsory for Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 2

Prerequisite: Basic language user.

Course goals: Developing all language skills; the adoption of grammatical structures, vocabulary, and an emphasis on functional English corresponding to the lower intermediate level (CEFR-A2).

Learning outcomes: Students can express themselves in writing and orally using simpler language structures and vocabulary needed for everyday communication. Students can understand less complex texts and are able to find the required information in the texts.

Course description:
Lectures:
Topics: Films, Language, Books, Science, Music, etc.
Grammar: uses of infinitive with to, uses of gerund, modal verbs (should, have to, must, might), conditional sentences 1 and 2, passive, present perfect – for and since, present perfect and past simple, past perfect....
Language functions: Practical English (at the pharmacy, getting around, travelling..).
Practice:
Determining and practicing the material covered in lectures using all language skills.

Literature:
Recommended:
1. C. Latham-Koenig, C. Oxeden, P. Seligson, English File 3rd edition, Student's Book, OUP, Oxford, 2012.
2. T. Hutchinson, Lifelines, Pre-Intermediate, Student's Book, OUP, Oxford, 2009.
3. Selection of texts from different sources.

Ancillary:
1. S. Stevanović, English Language 1 – Grammar Exercises, Workbook with Key, Technical Faculty in Bor, 2018.
2. R. Murphy, W.R. Smalzer, Basic Grammar in Use, CUP, Cambridge, 2007.
3. Selection of exercises from various sources.

Number of classes per week	**Lectures: 1**	**Practical classes: 1**	**Study research work:**	**Other forms of teaching:**

Teaching methods
Eclectic.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	30
Exercise attendance	5	Oral part of the final exam	40
Colloquium exam/s	20		
Term paper			

Study program: Mining Engineering, Metallurgical Engineering and Technological Engineering.

Course: STATISTICS

Lecturer: PhD Ivana Z. Đolović, full professor

Status of the course: Compulsory for Metallurgical Engineering, Technological Engineering and Engineering Management; Elective for Mining Engineering.

ECTS: 9

Prerequisite: Fundamental knowledge in mathematics.

Course goals: Students should be able to use appropriate mathematical and statistical concepts and tools in recognizing and solving problems.

Learning outcomes: Students should be able to apply theoretical knowledge from statistics in recognizing and solving tasks in further studying process as well as real problems in engineering, sciences, business and technology fields.

Course description:

Lectures:

Introduction (statistical data, frequency distribution, absolute and relative frequencies, cumulative frequency); Mean values (arithmetic mean, geometric mean, harmonic mean, median,); measures of dispersion (range, quartiles and interquartile range, mean absolute deviation, variance, standard deviation); Coefficient of variation and meaning; Coefficient of skewness; Pearson's moment coefficient of kurtosis (excess kurtosis); Discrete and continuous random variables; The Binomial probability distribution; The Poisson probability distribution; The normal distribution; - distribution; Student's t- distribution; Population and sample (types of sample, sample parameters); Point estimates of the population parameters; Confidence interval for population mean; Confidence interval for population proportion; Confidence interval for the difference of two population means; Confidence interval for the difference of two population proportions; Hypothesis tests; Hypothesis tests about the population mean; Hypothesis tests for the variance; Hypothesis tests of the equality of two means; Hypothesis tests about the population proportion; non-parametric tests; (-test of independence; -test of distribution); The correlation coefficient; Regression analysis; Coefficient of determination; standard error of the regression; Linear regression; Quadratic regression; Exponential regression; Logarithmic regression.

Practice:

Calculation exercises and application in real problems (with and without some statistical packages - advantages and disadvantages).

Literature:

Recommended:

1. I. Đolović, Statistika, Univerzitet u Beogradu, Tehnički fakultet u Boru, Bor, 2016.
2. I. Đolović, Zbirka zadataka iz statistike, Univerzitet u Beogradu, Tehnički fakultet u Boru, Bor, 2011.

Ancillary:

1. S.P. Mann, Uvod u statistiku (srpsko izdanje), Centar za izdavačku delatnost Ekonomskog fakulteta, Beograd, 2009.
2. S.P. Mann, Introductory Statistics (many editions in English).

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

Teaching methods

Frontal teaching for theoretical knowledge and group, individual and combined learning in practical parts of lessons (students engagement through active learning – applications and discussions).

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	20	Written part of the final exam	40
Exercise attendance		Oral part of the final exam	
Colloquium exam/s	40		
Term paper			

Study program: Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: PHYSICAL CHEMISTRY

Lecturer: PhD Marija B. Petrović Mihajlović, associate professor

Status of the course: Compulsory for Technological Engineering and Metallurgical Engineering. Elective for Mining Engineering (moduls PMD and RTSD).

ECTS: 9

Prerequisite: Acquired knowledge from General chemistry.

Course goals: Students acquaint physicochemical concepts, laws and principles. Theoretical base is set for studying of principles of structure and states of matter, physical processes and phase equilibrium in material systems, as well as chemical reactions and chemical equilibrium. Fundamentals of chemical thermodynamics and kinetics, as well as electrochemistry are introduced.

Learning outcomes: Students master and adopt fundamental physico-chemical terms and principles. Students identify and understand physicochemical processes associated with technological, metallurgical and mining processes. They acquire knowledge of experimental physicochemical methods, measurements and data processing.

Course description

Lectures:

1. Structure of the atom; Chemical bonding (ionic, covalent, metallic bonds, hybridization of atomic orbitals, delocalized molecular orbitals, chemical bonding in complex compounds, Van der Waals and hydrogen bonding); Aggregate states of matter; 2. Introduction to chemical thermodynamics; Thermodynamic properties of a multicomponent homogeneous system; Conditions of the phase equilibrium and phase transformations; Equilibrium in solutions; The heat of chemical reaction; Chemical affinity; Chemical equilibrium; Surface phenomena; Transport phenomena; Chemical kinetics; 3. Properties of electrolyte solutions; Electrochemical thermodynamics; Irreversible processes on the electrodes; Fundamentals of electrochemical kinetics.

Practice:

Experiments in the field of gaseous state of matter, chemical thermodynamics, chemical equilibrium, solutions, phase equilibrium, adsorption, kinetics and electrochemistry. Calculation exercises. 1st cycle: Determination of partial pressure; Determination of vapor pressure of liquids; Determination of viscosity; 2nd cycle: Structural analysis; Adsorption; Determination of reaction order and the rate constant; 3rd cycle: Determination of electrical conductivity; Electromotive forces; Corrosion of metals.

Literature:

Recommended:

1. S. Đ. Đorđević, V. J. Dražić, Fizička hemija, TMF, Beograd, 2005.
2. D. Minić, A. Antić-Jovanović, Fizička hemija, FFH, BF, Beograd, 2005.
3. D. Vučinić, S. Popov, Fizička hemija, Rudarsko-geološki fakultet, Beograd, 2014.

Ancillary:

1. D. Ovcin, D. Jovanović, V. Dražić, M. Maksimović, N. Jakovljević-Halai, Lj. Vračar, S. Jovanović, K. Jeremić, D. Šepa, M. Vojnović, Fizička hemija - zbirka zadataka, TMF, Beograd, 2004.
2. Z. Stanković, M. Rajčić-Vujasinović, Eksperimenti u fizičkoj hemiji, TF, Bor, 2006.
3. Lj. Vračar, A. Despić, V. Dražić, S. Zečević, K. Jeremić, D. Jovanović, S. Jovanović, M. Maksimović, B. Nikolić, D. Ovcin, D. Šepa, Eksperimentalna fizička hemija, TMF, Beograd, 2004.
4. S. Mentus, Lj. Damjanović, Fizičkohemijska analiza, Fakultet za fizičku hemiju, Beograd, 2015.
5. S. Golden, An introduction to theoretical physical chemistry, Addison-Wesley publishing company, INC., Reading Massachusetts, U.S.A., London, England, 1961.
6. R.I. Masel, Principles of adsorption and reaction on solid surfaces, A Wiley-interscience publication, John Wiley & Sons, INC., 1996.
7. J.E. House, Principles of chemical kinetics 2nd edition, Academic press, 2007.
8. M.K. Snyder, Chemistry: Structure and Reactions, Holt, Rinehart, Winston; 1966.

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

Teaching methods

Lecturing with interactive discussions, calculation and laboratory exercises, consultations and colloquiums.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	30
Exercise attendance	5	Oral part of the final exam	40
Colloquium exam/s	20		
Term paper			

Study program: Metallurgical Engineering, Technological Engineering

Course: MINERALOGY

Lecturer: PhD Mira Cocić, full professor

Status of the course: Compulsory for

ECTS: 8

Prerequisite: Basic chemistry knowledge

Course goals: Introducing students to basic knowledge of basic and special mineralogy

Learning outcomes: Acquiring necessary knowledge for mineral deposit exploration as well knowledge necessary for other professional subjects in metallurgy and technology areas

Course description:
Lectures:
Mineralogy: Subject, importance of minerals and their participation in construction of mineral raw material, classification of minerals. Basic mineralogy: crystallography, occurrence of crystal mineral shapes, crystal systems, crystallochemistry, crystallophysics, mineral genesis, methodology of mineral studies.
Special mineralogy: Silicate minerals (nesosilicates, sorosilicates, ciclosilicates, inosilicates, philosilicates and tectosilicates), non-silicate minerals (minelars Ca, Na, K, Mg, Ba, Sr, C, Cu, Au, Ag, Zn, Pb, Mo, Sb, Ni, Co, Sn, W, Bi, As, S, Te, Se, Hg, Al, Fe, Cr, Mn).
Practice:

Practices in mineralogical collection: crystallography of minerals, recognition of minerals.

Literature:

Recommended:

1. D. Babič, Mineralogy, Belgrade, 2003.
2. S. Janjić, Mineralogy, Naučna knjiga, Belgrade, 1995.

Ancillary:

1. Ž. Milićević, Mineralogy, Authorized lectures available in electronic form, 2009.

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

Teaching methods

Lectures, practices, practical lectures, colloquiums

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	
Exercise attendance	5	Oral part of the final exam	40
Coloquium exam/s	25 + 25		
Term paper			

Study program: Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: ENGLISH LANGUAGE 2a

Lecturer: Sandra Vasković

Status of the course: Compulsory for Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 4

Prerequisite: Completion of the program English language 1b.

Course goals: Developing language competences (listening, reading, speaking, writing); acquiring grammatical structures, vocabulary and language functions according to CEFR level A2.

Learning outcomes: Students understand written texts with language structures and vocabulary which are used by wider academic community. Students are able to give simple answers to the questions which are related to below mentioned topics, as well as to find the required information from a text.

Course description:

Lectures:

Language points: Revision of tenses (Present Simple and continuous, Past Simple and Continuous, Present and Past Perfect, going to - future, Future Simple); Modal verbs (can, may, must, should, needn't…); Conditionals (Zero, First, Second and Third); Word formation (common prefixes and suffixes)

Language functions: describing pictures and personality types, discussing, giving arguments - pros and cons, expalaining – giving opinion, comparing (different cultures), giving suggestions

Topics: Personality types, Communication, Cultural differences, Environment issues, Healthy Lifestyle.

Practice:

Enhancing and practising the language structures introduced during lectures, by using the acquired language skills.

Literature

1. M. Manzalovic– The Script for English language 2a – collection of texts with grammar and vocabulary exercises.
2. R. Murphy, W.R. Smalzer – Grammar in Use, intermediate (CUP, Cambridge 2007).
3. A selection of grammar exercises taken from the Internet sites.

Number of classes per week	**Lectures: 1**	**Practical classes: 1**	**Study research work:**	**Other forms of teaching:**

Teaching methods

Communicative Language Teaching, The Direct Method, Grammar-Translation Method, Audi-Visual; Teaching models: frontal, pair, group and individual work.

Knowledge evaluation (maximum 100 points)

Pre-exam obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	20
Exercise attendance		Oral part of the final exam*	40
Colloquium exam/s	30		
Term paper (presentation)			

*Students have the right to take oral exam if they have gained at least 25 points at the colloquium and the written exam.

Study program: Metallurgical Engineering

Course: TESTING OF METALS 1

Lecturer/s: dr Uroš Stamenković, assistant professor

Status of the course: Obligatory subject for the students in the second semester of the second year

ECTS: 9

Prerequisite: Requires knowledge in Physics, General Chemistry and Inorganic Chemistry

Course goals: Providing the basic knowledge in the field of mechanical testing, fracture mechanics, toughness of metals, metal fatigue and metal creep.

Learning outcomes: Acquiring the theoretical and the practical knowledge for working in the areas of metal

quality control in factories, in specialized laboratories and working in research that is based on physics of the materials.

Course description:

Lectures:

Stress and Strain. Mechanical Testings. Tensile testing, Compression test, Torsion test, Bend test, and Shear test. Ductility and Fracture, Ductile Fracture, Brittle Fracture, Fracture Mechanic. ***Impact Toughness of Metals****. Fracture Toughness, Test Methods, Charpy Impact test, Impact Test Specimens, Factors Affecting Impact Toughness.* ***Metal Fatigue****. Types of Fatigue Loading, S-N (Wöhler) Curves, Diagrams of Dynamic Endurance: Gerber Diagram, Haigh Diagram, Smith Diagram. Factors Affecting Fatigue, Mechanism of Metal Fatigue.* ***Metal Creep****. Phenomenology of Creep, Stages of Creep, Temperature and Stress Dependence of Creep, Dislocation Creep, Diffusion Creep, Grain Boundary Creep, Deformation Mechanism Maps, Factors Affecting Creep, Materials Selection for High-Temperature Use, Stress Relaxation.* ***Hardness Testing.*** *Brinell Hardness Test, Meyer Hardness Test, Vickers Hardness Test, Rockwell Hardness Test, Dynamic Hardness Testing Methods, Portable Dynamic Hardness Testing.* ***Technological Tests of Metals.***

Practical studies: *Theoretical studies are followed by laboratory exercises in the field of mechanical testing*

Literature:

Recommended:

1. J. R. Davis (editor), Tensile Testing, Second Edition, ASM International, Materials Park, Ohio, 2004.
2. J. Rösler, H. Harders, M. Bäker, Mechanical Behaviour of Engineering Materials, Springer-Verlag, Berlin, Heidelberg, 2007

Ancillary:

1. Jaap Schijve, Fatigue of Structures and Materials, Kluwer Academic Publishers, New York, 2004.

Number of classes per week	**Lectures: 3**	**Practical classes: 1**	**Study research work: /**	**Other forms of teaching: 2**

Teaching methods: Lectures and lab exercises.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	
Exercise attendance	**15**	Oral part of the final exam	**60**
Coloquium exam/s	**20**	.....	

Study program: Metallurgical Engineering

Course: METALLURGICAL THERMODYNAMICS 1

Lecturer/s: Dr. Vesna Grekulović, full professor

Status of the course: Compulsory

ECTS: 9

Prerequisite: Knowledge in Mathematics and Physical chemistry is required

Course goals: Training students for independent work in the thermodynamic calculations of metallurgical processes and the application of the modern software in the field of metallurgical thermodynamics.

Learning outcomes: Students should learn the basic principles of calculations in metallurgical thermodynamics in order to obtain the necessary basis for further study of metallurgical processes and various technologies in the field of extractive metallurgy and the production of metal materials.

Course description:

Lectures:

Historical development of thermodynamics. Basic terminology in thermodynamics. Thermodynamics of ideal and real gas. The first law of thermodynamics. State change at constant volume and pressure. Internal energy. Entalpy. Heat capacity. Application of the first law of thermodynamics in metallurgical thermochemistry. The second law of thermodynamics. Change of entropy for reversible and irreversible processes. Entropy of mixing. Statistical interpretation of entropy. Maxwell's relations. Thermodynamic potentials. Gibbs's energy. Helmholtz's energy. Chemical potential of pure substance. Fugacity and activity. Application of the second law of thermodynamics in metallurgical thermochemistry. Formulation and application of the third law of thermodynamics. Nernst's theorem. General conditions of chemical equilibrium. Affinity of chemical reaction and chemical equilibrium. Determining the standard equilibrium constant and the effect of temperature. Chemical balance for ideal and real gases. Balance of chemical reactions in homogeneous and heterogeneous systems. Stability of pure substances. Phase transformation. Clapeyron's equation. Gibbs's phase rule. Ideal solutions. Real solutions. Diluted solutions. Partial molar properties. Mixing functions. Excess functions. Gibbs-Duhem equation. Graphical interpretation of thermodynamic state functions.

Practice:

Exercises, Other forms of teaching, Study research work

Calculations and laboratory exercises follow lectures. Application and construction of: Ellingham diagrams; E-pH diagrams; PSD diagrams. Application of software “HSC Chemistry” in thermodynamic calculations.

Literature:

Recommended:

1. V. Grekulović, M. Rajčić-Vujasinović, A. Mitovski, Metallurgical Thermodynamics 1, TF Bor, 2022. (in Serbian)

2. D.Živković, Introduction to metallurgical thermodynamics, Authorized lectures, TF Bor, 2011. (in Serbian)

3. Ž.Živković, V.Savović: Principles of metallurgical thermodynamics, Bakar, Bor, 1997. (in Serbian)

4. D.Živković, Ž.Živković: Theory of metallurgical processes workbook, Part I – Introduction to metallurgical thermodynamics, Bakar, Bor, 1994. (in Serbian)

5. D.Živković, Ž.Živković: Theory of metallurgical processes workbook, Part II – Thermodynamics od solutions, Thermodynamics of crystal defects, Kinetics of metallurgical reactions, Grafomed, Bor, 2001. (in Serbian)

Ancillary:

1. M.D.Koretsky, Engineering and chemical thermodynamics, 2nd Edition, John Willey&Sons Ltd., 2013.

2. H.Donald Brooke Jenkins, Chemical thermodynamics at a glance, Blackwell Publishing, Oxford, 2008.

3. S.Stolen, T.Grande, N.L.Allan, Chemical thermodynamics of materials, John Willey&Sons Ltd., 2004.

4. D. R. Gaskell, Introduction to the Thermodynamics of Materials, 4th Edition, Taylor & Francis, New York, 2003.

5. O.F.Devereux, Topics in Metallurgical Thermodynamics, MIR, Moscow, 1986.

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

Teaching methods

Lectures, exercises and practical work, organized on an interactive principle, which besides classical lectures and presentations, includes discussions and active participation of students in all aspects of teaching.

Knowledge evaluation (maximum 100 points)			
Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	30
Exercise attendance	5	Oral part of the final exam	30
Coloquium exam/s	3x10	.....	
Term paper			

Study program: Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: ANALYTICAL CHEMISTRY

Lecturers: PhD Tanja S. Kalinović, assistant professor

Status of the course: Compulsory for Technological engineering and Metallurgical Engineering; Elective for Mining Engineering (modules PMD and RTSD).

ECTS: 6

Prerequisite: Acquired knowledge of General chemistry and Inorganic chemistry.

Course goals: Acquiring and mastering theoretical foundations, basic techniques, operations and skills necessary for quantitative chemical analysis. Application of theoretical knowledge in calculations and practical work in the chemical laboratory.

Learning outcomes: Training students to assess the quality of samples of various industrial raw materials and products, as well as to monitor and control the parameters of technological processes and the quality of environmental parameters.

Course description:

Lectures:

Determining the necessary knowledge for successful monitoring and adoption of the planned course curriculum. Subject and aims of Analytical Chemistry. Classification of methods, principles, techniques and basic operations of quantitative chemical analysis. Gravimetric analysis: Principles of gravimetric analysis, precipitation reactions, types of precipitates, conditions for the precipitates formation, calculations in gravimetry, ion separation methods, gravimetric determination of individual cations and anions in aqueous solutions. Volumetric analysis: Principles of volumetric analysis, classification of volumetric methods, indicators and calculations in volumetrics, volumetric determination of individual cations and anions in aqueous solutions.

Practice:

Laboratory exercises: Gravimetric determinations; Volumetric determinations (neutralization methods, oxido-reduction methods, complexometric methods, precipitation methods). Calculation exercises.

Literature:

Recommended:

3. E. Lončar, Analitička hemija, Tehnološki fakultet, Novi Sad, 2013.
4. O. Vitorović, R. Šaper, Analitička hemija–teorijske osnove, Tehnološko-metalurški fakultet, Beograd, 1989.
5. J. Savić, M. Savić, Osnovi analitičke hemije, Svjetlost, Sarajevo, 1990.
6. Lj. Rajaković, A. Perić-Grujić, T. Vasiljević, D. Čičkarić, Analitička hemija, Kvantitativna hemijska analiza, Praktikum, Tehnološko-metalurški fakultet, Beograd, 2000.
7. Lj. Rajaković, Analitička hemija – Zbirka zadataka, Tehnološko-Metalurški fakultet, Beograd, 2005.

Ancillary:

2. D.A. Skoog, D.M. Holler, Osnove analitičke kemije, Školska knjiga, Zagreb, 1999.

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

Teaching methods

Classical lectures with interactive discussions, calculation and laboratory exercises, consultations and colloquium exams.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	45
Exercise attendance	10	Oral part of the final exam	
Colloquium exam/s	40		
Term paper			

Study program: Metallurgical Engineering

Course: ELECTROCHEMISTRY

Lecturer/s: Dr. Vesna Grekulović, full professor, Dr. Milan Gorgievski, Associate professor

Status of the course: Elective for Metallurgical Engineering and Technological Engineering

ECTS: 4

Prerequisite: Knowledge from physical chemistry

Course goals: Goal of the subject is to introduce students with the basic subjects and lows related to the structure of electrochemical systems and electrode processes which appear in electrochemical engineering

Learning outcomes: Student capable for independent managing and control of electrochemical processes in metallurgy an inorganic chemical technology

Course description:

Lectures:

Electrochemical system (structure, electrodes, electrolyte). Electrochemical sources and consumers of electrical energy. Thermodynamics of electrochemical systems. Conductivity of solutions and melts. Basic kinetics equations in electrode processes. Current efficiency and energy consumption. Measurement methods in electrochemistry. The most important electrochemical processes in metallurgy and inorganic chemical technology (hydrogen evolution and oxidation, evolution and reduction of oxygen, electrochemical extraction and refining of metals, chlorine-alkaline electrolysis, electroplating, anodizing, electrochemical synthesis of oxides)

Practice:

Laboratory exercises follow content of the lectures

Literature:

Recommended:

1. M. Rajčić-Vujasinović, V. Grekulović, Teorija hidro i elektrometalurških procesa, TF Bor, 2017.

2. A. Despić, Osnove elektrohemije 2000, Zavod za udžbenike i nastavna sredstva, Beograd, 2003. (in Serbian)

Ancillary:

1. M. Rajčić-Vujasinović, V. Zlatković, Teorija hidro i elektrometalurških procesa, Praktikum za vežbe, TF Bor, 2001. (in Serbian)

2. Z. Stanković, M. Rajčić-Vujasinović, Praktikum za vežbe iz Fizičke hemije, TF Bor, (in Serbian)

3. S. Đorđević i drugi, Galvanotehnika, Tehnička knjiga, Beograd, 1998. (in Serbian)

4. J. O`M. Bockris, Modern Aspects of Electrochemistry, Plenum Press, New York, 1973.

5. K. Izutsu, Electrochemistry in Nonaqueous Solutions, Wiley-Vch Verlag GmbH and Co, 2002.

Number of classes per week	**Lectures: 2**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching:**

Teaching methods

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	
Exercise attendance	10	Oral part of the final exam	60
Coloquium exam/s	20	.....	
Term paper			

Study program: Metallurgical Engineering

Course: INTRODUCTION TO METALLIC MATERIALS

Lecturer/s: dr Uroš Stamenković, assistant professor

Status of the course: Elective subject for the students in the second semester of the second year

ECTS: 4

Prerequisite: Requires knowledge in Physical chemistry

Course goals: The goal of this course is to provide theoretical and practical basics to students about metallic materials and technologies.

Learning outcomes: The outcome of this course is to gain knowledge about the different metallic materials, their structures, properties and applications.

Course description:

Lectures:

Introduction. Engineering materials, classification, metals, ceramics, glass, polymers, composites. Material properties: mechanical, electrical, magnetic, optical. Material processing - general terms. Chemical bonding types. Crystalline and amorphous structures. Crystalline structure of metallic materials, types of crystal lattices. Defects in crystal structures, point, linear, interfacial, and volume defects, and their importance. Diffusion. Basic terms in the theory of alloys. Pure metals. Solid solutions. Interstitial solid solutions. Substitutional solid solutions. Intermediate compounds. Eutectic reactions. Cooling curves. Characteristics. Basic types of phase diagrams. Unit cell. Miller indices of planes and directions. Behavior of materials in the state of mechanical loading. Stress -

Deformation: metals. Elastic deformation. Plastic deformation. Phase diagrams of alloys – binary isomorphous systems with complete solid solubility. Phase diagrams of alloys - binary systems with intermediate phases/compounds. Phase diagrams of alloys - binary eutectic systems with limited solid solubility. Characteristics and applications. Metals and alloys. Irons and steels. Nonferrous metals and alloys (Aluminium alloys, Copper alloys, Titanium alloys, other nonferrous metals). Superalloys.

Practical studies: *Exercises that follow the presented materials in lectures.*

Literature:

Recommended:

1. W.D. Callister, D.G Rethwisch, Materials Science and Engineering: An Introduction, 8th Ed., Wiley and Sons, 2010.
2. Y. Lakhtin, Engineering, physical metallurgy and heat-treatment, English translation from the Russian by Nicolas Weinstein, Second printing, Mir Publishers, Moscow, 1983.

Ancillary:

1. M.F. Ashby, D.R.H. Jones, Engineering Materials 2 - An Introduction to Microstructures, Processing and Design, Butterworth-Heinemann, UK, 1999.

Number of classes per week	**Lectures: 2**	**Practical classes: 1**	**Study research work: /**	**Other forms of teaching: 1**

Teaching methods: Lectures and lab exercises.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	
Exercise attendance	**10**	Oral part of the final exam	**60**
Coloquium exam/s	**30**	.....	

Study program: Metallurgical Engineering

Course: PHYSICAL METALLURGY 1

Lecturer/s: Ivana Markovic, Associated Professor

Status of the course: Mandatory subject of the Metallurgical Engineering study program

ECTS: 6

Prerequisite: Required knowledge of Physics, Physical Chemistry, Knowledge of metal materials

Course goals: Providing knowledge in the field of metallography, phase diagrams and iron and iron alloys.

Learning outcomes:

Acquiring the knowledge necessary for successfully following classes in other subjects in the higher years of study.

Course description:

Lectures:

Elements of crystallography. Lattice and crystal structure. Crystal Systems and Brave's Grids. Elements of crystal symmetry. Marking of crystal planes and directions. Basics of metallography. Microscopy of metals. Macroanalysis of the structure of metals and alloys. Microanalysis of the structure of metals and alloys. Structure of alloys. Mechanical mixtures. Solid solutions. Chemical compounds. Intermediate phases. Methods of determining transformation points. Equilibrium state phase diagrams. Two-component alloys. Alloys with discontinuity in solubility in liquid condition. Alloys with complete solubility in liquid and solid state. Alloys with discontinuity in solubility in solid state. Alloys with an intermetallic compound. Alloys with transformation in the solid state. Three-component alloys. Iron and iron alloys. Iron-carbon phase diagram.

Practice:

Theoretical teaching is followed by laboratory exercises in the field of metallographic analysis of metals and alloys.

Literature:

Recommended:

1. D. Marković, Fizička metalurgija 1, Autorizovana skripta, Univerzitet u Beogradu, Tehnički fakultet u Boru, Bor, 2013.
2. H. Šuman, Metalografija, Tehnološko-metalurški fakultet u Beogradu, Beograd, 1989.
3. R. Kontić, Ž. Blečić, Metalografija, Metalurško-tehnološki fakultet, Podgorica, 1993.

Ancillary:

1. I. Marković, S. Ivanov, D. Marković, Fizička metalurgija 1 – praktikum, Univerzitet u Beogradu, Tehnički fakultet u Boru, Bor, 2018.
2. G. F. Vander Voort, Metalography – Principles and Practice, ASM International, Materials Park, Ohio, 1999.
3. H. K. D. H. Bhadeshia, R. W. K. Honeycombe, Steels – Microstructure and Properties (Third Edition), Elsevier Butterworth-Heinemann, Oxford, 2006.
4. S.H. Avner, Introduction to Physical Metallurgy, McGraw-Hill, New York, 1964.

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

Teaching methods

Lectures, exercises-practical teaching, preparation of a term paper with a consulting approach to independent work students.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	
Exercise attendance		Oral part of the final exam	70
Coloquium exam/s	30	Practical lectures	
Term paper			

Study program: Metallurgical Engineering

Course: TESTING OF METALS 2

Lecturer/s: dr Saša R. Marjanović, Associate Professor

Status of the course: Compulsory for Module: Processing metallurgy

ECTS: 6

Prerequisite: Necessary knowledge of physics, general chemistry, inorganic chemistry, physical chemistry.

Course goals: Providing basic knowledge in the field of physical testing of metals, defectoscopic testing and the field of X-ray structural analysis and electron microscopy.

Learning outcomes: Acquisition of theoretical and professional knowledge for dealing with metal quality control in plants and specialized laboratories and conducting research work in the field of metal physics.

Course description:
Lectures: Non-destructive testing. Capillary defectoscopy, magnetic defectoscopy, eddy current defectoscopy, ultrasonic defectoscopy, ionizing radiation defectoscopy. Examination of internal friction. X-ray structural analysis. Bragg equation of diffraction, methods of X-ray structural analysis, X-ray indexing, application of X-ray structural analysis in metallurgy. X-ray spectral analysis and X-ray microprobe. Electron microscopy. Transmission electron microscope, scanning electron microscope, analytical electron microscopy. Scanning probe microscopy.
Practice: Theoretical teaching is followed by laboratory exercises in the field of defectoscopy and X-ray structural analysis.

Literature:

Recommended:

1. Д. Марковић, Испитивање метала II, Ауторизована предавања,ТФ Бор, 2012.
2.Б. Сладојевић, Испитивање материјала ултразвуком, Институт Кирил Савић, 1997.
3. М. Јовић, С. Александровић, С. Николић, Магнетна дефектоскопија челичних ужади, Београд, Промеззија, 1999.
4. Т. Ненадовић, Контрола квалитета материјала, Београд, Институт Винча, 2003.
5. Љ. Карановић, Д. Полети, Рентгенска структурна анализа, Београд, Завод за уџбенике и наставна средства, 2003.
6. Ј. Раногајец, Методе карактеризације материјала, Технолошки факултет, Нови Сад, 2005.

Ancillary:

1. Paul E. Mix, Introduction to nondestructive testing, Second edition, John Wiley & Sons, Inc., Hoboken, New Jersey, 2005.
2. Charles J. Hellier, Handbook of Nondestructive Evaluation, Mc Graw-Hill, New Yor, 2003.
3. Б. Прелесник, К. Анђелковић, Д. Радановић, Т. Тодоровић, Збирка задатака из кристалографије и рентгенске структурне анализе, Хемијски факултет, Београд, 2007.
4.A. Puškár, Internal Friction of Materials, Cambridge International Science Publishing, 2001
5. V. K. Pecharsky, P. Y. Zavalij, Powder Diffraction and Structural Characterization of Materials, Springer 2005.
5. R. F. Egerton, Physical Principles of Electron Microscopy, Springer, 2005.
6. D. B. Williams, C. B. Carter, Transmission Electron Microscopy, Springer, 2009.

Number of classes per week	**Lectures: 3**	**Practical classes: 3**	**Study research work: ?**	**Other forms of teaching: ?**

Teaching methods

Classical lectures, exercises in the laboratory

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	
Exercise attendance	**15**	Oral part of the final exam	*50*
Coloquium exam/s	**2 x 15 = 30**	.....	
Term paper			

Study program: Metallurgical Engineering

Course: THEORY OF PYROMETALLURGICAL PROCESSES

Lecturer/s: Dr. Dragan Manasijević, full professor

Status of the course: Elective subject

ECTS: 8

Prerequisite: Required knowledge of physical chemistry and metallurgical thermodynamics.

Course goals: Preparation of students for other professional metallurgical subjects, above all metallurgy of non-ferrous metals, iron metallurgy, steel metallurgy, metallurgy of rare metals, etc.

Learning outcomes: Acquiring the necessary theoretical knowledge about the thermodynamic and kinetic aspects of basic metallurgical processes.

Course description:
Theoretical basics of pyrometallurgical processes of drying, calcination, roasting, smelting, reduction, oxidation and refining. Thermodynamic bases of pyrometallurgical processes. Theory of the processes of dissociation of carbonates, oxides, sulfides and halides. Theory of roasting of sulfide minerals. PSD diagrams. Theory of sulfide smelting. Theory of oxidation process. Theory of reduction of oxides and reduction smelting. Ellingham's and Pourbaix-Ellingham's diagrams. Reduction with carbon. Reduction with Carbon Monoxide. Reduction with Hydrogen. Metallothermic reduction. Kinetics of reactions in multicomponent metallurgical systems. Kinetics of heterogeneous reactions in isothermal conditions. Non-isothermal kinetics. Basic methods of thermal analysis. Theory of silicate systems. Slags in metallurgical processes, role and function. Structure of silicate systems. The theory of the refining processes. The theory of liquidation processes. Theory of special processes for obtaining high-purity metals.

Literature:

Recommended:

1. D. Manasijević, D. Živković, The Basics of Pyrometallurgical Processes (Part 1), Technical faculty in Bor, Bor, 2011. *(in Serbian)*
2. Ž.Živković, V.Savović: Theory of Pirometallurgical Processes, Bakar, Bor, 1994. *(in Serbian)*
3. D. Živković, Ž.Živković: The Collection of Tasks From Theory of Metallurgical Processes, Part I - Introduction to Metallurgical Thermodynamics, Bakar, Bor, 1994 *(in Serbian)*
D. Živković, Ž.Živković: Collection of tasks from the theory of metallurgical processes, II part - thermodynamics of solution, Thermodynamics of defects in crystals, Kinetics of metallurgical reactions, Grafomed, Bor, 2001. *(in Serbian)*

Ancillary:

1. T. Rosenquist, Principles of Extractive Metallurgy. Tapir Academic Press, Trondheim, 2004.
2. C. K. Gupta, Chemical Metallurgy: Principles and Practice, WILEY-VCH, Weinheim, 2003.
3. F.Habashi, Textbook of Pyrometallurgy, Laval University, Canada, 2002.
4. A. Ghosh, H. S. Ray, Principles of Extractive Metallurgy, New Age International, 1991.
5. M. SHAMSUDDIN, PHYSICAL CHEMISTRY OF METALLURGICAL PROCESSES, John Wiley & Sons, Inc., Hoboken, New Jersey, 2016.

Number of classes per week	**Lectures: 3**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching: 1**

Teaching methods

Teaching includes lectures, exercises - computational and experimental.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**10**	Written part of the final exam	**20**
Exercise attendance	**10**	Oral part of the final exam	*40*
Coloquium exam/s	**20**	.....	
Term paper			

Study program: Metallurgical Engineering

Course: PROCESSING OF METALS IN A PLASTIC STATE 1

Lecturer/s: dr Saša R. Marjanović, Associate Professor

Status of the course: Compulsory for Module: Processing metallurgy

ECTS: 8

Prerequisite: Necessary knowledge of mathematics, physics and physical metallurgy.

Course goals: The course should enable the student to study the processes that take place in solid metal (alloy) under the influence of stress that cause a change in shape and dimensions with a constant value of the volume, whereby the greatest attention is paid to rolling as the most common method of metal processing in general.

Learning outcomes: The student should become familiar with the processes of metal flow in the solid state and master specific rolling technologies in order to be able to work effectively independently and in a team in this area.

Course description:
Lectures: Correlation of deformation and structural changes in metal. Characteristics of hot and cold plastic deformation. Reinforcement and texture. Recrystallization and fibrous structure. Reinforcement diagrams of metals and alloys. The role of crystal structure defects in plastic deformation processing. Thermomechanical mode of metal processing. Diagrams of recrystallization, equilibrium state, resistance to deformation and plasticity of metals. Technological features and TMR of metal processing. Superplasticity. Rolling of metals and alloys. General scheme of technological process in rolling mills. Division and purpose of semi-finished products. Types of rolling mills. Technological process of rolling blooms, slabs and billets. Preparation of semi-finished products for further processing. Profile rolling. Types of rolling mills. Calibration. Rolling of wire and profiles of small cross-sections. Rolling of sheets and strips. Rolling of seamless pipes. Rolling of balls, banadage and wheels. Problems and errors in valid products.
Practice: Computational and laboratory exercises follow the lectures. Determination of TMR processing for a specific alloy, calibration.

Literature:

Recommended:

1. М. Пешић, Б. Мишковић, В. Миленковић, Прерада метала у пластичном стању, ТМФ, Београд, 1992.
2. Ђ. Дробњак, Физичка металургија, Физика чврстоће и пластичности, ТМФ, Београд, 1990.
3. М. Чаушевић, Обрада метала ваљањем, В. Маслеша, Сарајево, 1985.
4. Б. Перовић, Физичка металургија, МТФ, Подгорица, 1997.

Ancillary:

1. S. H. Talbert, B. Avitzuk, Elementary Mechanics of Plastic Flow in Metal Forming, John Wiley & Sons, 1996.
2. Metal forming - mechanics and metallurgy, William F. Hosford, Robert M. Caddel, 2007.
3. P. I. Poluhin, Tehnologija procesov obrabotki metallov, davleniem, Metallurgija, Moskva, 1988.
4. Б. Мишковић, М. Мишовић, Р. Стефановић, Калибровање ваљака у ваљаоницама челика и обојених метала, Савез инжењера металургије Југославије, ТМФ, Београд, 1997.
5. A. Tselikov, Stress and Strain in Metal Rolling, University Press, L.A., 2003.
6. G. E. Dieter, Mechanical Metallurgy, Mc Graw-Hill, London, 1986.

Number of classes per week	**Lectures: 3**	**Practical classes: 3**	**Study research work: ?**	**Other forms of teaching: ?**

Teaching methods

Lectures and computational exercises are organized on an interactive basis, which, in addition to classic lectures and presentations, includes discussions and active participation of students during classes.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	**20**
Exercise attendance	**5**	Oral part of the final exam	*50*
Coloquium exam/s	**1 x 20 = 20**	.....	
Term paper			

Study program: Metallurgical Engineering

Course: METALLURGICAL OPERATIONS

Lecturer/s: Dr. Vesna Grekulović, full professor, Dr. Milan Gorgievski, associate professor

Status of the course: Elective for the tudy program Metallurgical Engineering (Module: Extractive metallurgy)

ECTS: 8

Prerequisite: Knowledge in mathematics and physical chemistry is required

Course goals: The aim of the course is to prepare a student for solving problems in the field of fluid mechanics and dispersion systems, mass transfer and mass transfer operations, that occur in metallurgy.

Learning outcomes: Acquiring theoretical and practical knowledge from the fields mentioned above, necessary for further study of different metallurgical processes.

Course description:

Lectures:

Mechanics of fluid and dispersion systems. Introduction, transport characteristics of the fluid; basic equations for stagnant and flowing fluids and momentum transfer; engineering aspect of fluid mechanics; transport of fluids. Mechanics of a body obstruction by fluid; movement of particles in the field of force; modes of motion of particles; free and cramped deposition; phase separation operations in the gravitational field of force; thickening, hydraulic transport; phase separation operations in a centrifugal field; electrostatic precipitation. Three-phase systems - gas washing. Fluid flow through a porous media; filtration; filtration of gases. Fluidization.

Mass transfer and mass transfer operation: Molecular mass transfer, transport characteristics; basic mass transfer equations. Convective mass transfer. Similarity criteria of mass transfer; models of mass transfer. Equilibrium in multiphase systems; transfer unit height and number of mass transfer units; separation, concentration and refining; absorption, distillation and rectification; liquid-liquid extraction; leaching; adsorption; drying; membrane processes.

Practice:

Computational and laboratory exercises follow lectures.

Literature:

Recommended:

1. V. Stanković, Fenomeni prenosa i operacije u metalurgiji 1, Univerzitet u Beogradu, Tehnički fakultet Bor 1998. (in Serbian)

2. V. Stanković, Fenomeni prenosa i operacije u metalurgiji 1, Univerzitet u Beogradu, Tehnički fakultet Bor 1998. (in Serbian)

3. F. Zdanski, Mehanika fluida, Tehnološko-metalurški fakultet, Univerziteta u Beogradu; 1995. (in Serbian)

4. S. Šerbula, and V. Stanković, Praktikum za vežbe iz metalurških operacija, Univerzitet u Beogradu, Tehnički fakultet Bor 2006. (in Serbian)

5. S. Cvijović, N. Bošković-Vragolović, R. Pjanović, Fenomeni prenosa i tehnološke operacije-zbirka zadataka sa izvodima iz teorije, Akademska misao, Beograd, 2006. (in Serbian)

Ancillary:

1. A.G. Kasatkin, Osnovi processi i apparati himiceskoi tehnologii, Himija, Moskva, 1973. (in Russian)

2. J. Szekely, N.J. Themelis, Rate Phenomena in Process Metallurgy, John Wiley & Sons, New York; 1971.

3. L. D. Schmidt, The Engineering of Chemical Reactions, Oxford University Press, 1998.

Number of classes per week	**Lectures: 3**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching: 1**

Teaching methods

Lectures, computational and laboratory exercises.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	20
Exercise attendance	10	Oral part of the final exam	40
Coloquium exam/s	2x20	.....	
Term paper			

Study program: Metallurgical Engineering,

Course: Theory of foundry

Lecturer/s: : Dr. A. Srba Mladenović, full prof.

Status of the course: Elective for Metallurgical Engineering

ECTS: 8

Prerequisite: knowledge of physical metallurgy

Course goals: Training students for independent work within the processes that take place in the foundry.

Learning outcomes: Students should learn the basic phenomena in foundry processes.

Course Description: Metal melting. The viscosity of metals melts. Surface tension. The fluidity of melting metals and alloys. Basics of the theory of the casting formation process. Formation of the casting structure. Thermodynamics of the casting formation process. Shrinkage of metals and alloys. Shrinkage cavities. The theory of shrinkage cavities formation. The influence of technological factors and composition of alloys on the formation of shrinkage cavities. The methods of elimination of casting porosity and shrinkage cavities. Segregation. Nonmetallic inclusions. Gasses in the metals. Cracks and stresses in the castings. Residual thermal stresses. Time residual stresses. Stresses due to the phase transformation processes. Microscopic and submicroscopic stresses. Consequences from the residual stresses in castings. Methods of determining residual casting stresses.

Lectures:

Practice: *Computational and laboratory exercises follow the lectures.*

Literature:

Recommended:

3. Carl R. Loper, Philip C. Rosenthal, Richard W. Heine, PRINCIPLES OF METAL CASTING, McGraw Hill Higher Education, 1 January 1976

Ancillary:

2. Bruce Chalmers, Principles of Solidification, John Wiley & Sons, 1 September 1964

Number of classes per week	**Lectures: 3**	**Practical classes: 3**	**Study research work: ?**	**Other forms of teaching: ?**

Teaching methods

Lectures, exercises, and practical work, organized on an interactive principle, which in addition to classical lectures and presentations includes discussions and active participation of students.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	**20**
Exercise attendance	**15**	Oral part of the final exam	*35*
Coloquium exam/s	**15**	.....	
Term paper	**10**		

Study program: Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: ENGLISH LANGUAGE 2b

Lecturer: Slavica Stevanović

Status of the course: Compulsory for Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 4

Prerequisite: Completion of the program English language 2a.

Course goals: Developing language competences (listening, reading, speaking, writing); acquiring grammatical structures, vocabulary and language functions according to CEFR level B1.

Learning outcomes: Students understand written texts with language structures and vocabulary which are used by a wider academic community. Students are able to summarise the texts related to the below mentioned topics, as well as to express their own opinion.

Course description:

Lectures:

Language points: Relative Clauses; - ING form (various uses); Passive Voice ; Word formation – compound words, common prefixes and suffixes

Language functions: comparing, giving arguments, translating, explaining, planning, analyzing, making conclusions, scanning , skimming

Topics: Globalisation, Management Skills, The History of Money, Famous Failures, Moral Stories.

Practice:

Enhancing and practicing the language structures introduced during lectures, by using the acquired language skills.

Literature

1. M. Manzalovic – The Script for English language 2a – collection of texts with grammar and vocabulary exercises.
2. R. Murphy, W.R.Smalzer - Grammar in Use, intermediate (CUP, Cambridge 2007)
3. A selection of grammar exercises taken from the Internet sites.

Number of classes per week	**Lectures: 1**	**Practical classes: 1**	**Study research work:**	**Other forms of teaching:**

Teaching methods

Communicative Language Teaching, The Direct Method, Grammar-Translation Method, Audi-Visual; Teaching models: frontal, pair, group and individual work.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	20
Exercise attendance		Oral part of the final exam*	40
Colloquium exam/s	30		
Term paper (presentation)			

*Students have the right to take oral exam if they have gained at least 25 points at the colloquium and the written exam.

Study program: Engineering Management, Technological Engineering Mining Engineering and Metallurgical Engineering

Course title: ENGLISH LANGUAGE 3a

Lecturer: Enisa S. Nikolić

Status of the course: Compulsory for Engineering Management, Technological Engineering, Mining Engineering and Metallurgical Engineering.

ECTS: 2

Prerequisite: Pre-intermediate to intermediate level of language proficiency.

Course goals: Further development of students' language competence in academic and professional contexts, which includes the development of all language skills. Introduction of professional vocabulary and the relevant language material related to the study programs taught at the Technical Faculty in Bor, so that the students could use professional literature and communicate in English (in written and oral form) in academic or professional settings.

Learning outcomes: Students have mastered the specific vocabulary, grammar structures and language functions that are characteristic of academic and professional contexts and, to a greater or lesser extent, are able to: independently use professional literature and translate scientific and professional texts of various levels of complexity, present and discuss the topics that have been dealt with in classes and to express themselves in short written forms (short composition, summary, short comment, CV and the cover letter).

Course description:

Lectures:

Grammar points: Revision of Tenses (Present Simple/Continuous, Present Perfect Simple/Continuous, Past Simple/Continuous, Past Perfect Simple/Continuous, Future Simple/Continuous, going to structure); Modalverbs referring to present, future and past; Noun groups, Compounds, Foreign Plurals, Word formation (common prefixes and suffixes); The Passive Voice (revision of passive structures, impersonal passive constructions, questions in the passive); Linking words 1.

Language functions: Seeking information, Giving advice, Expressing opinion, Agreeing/ Disagreeing.

Topics: Why English Matters, The Importance of English for Engineers, Science and Engineering, Famous Scientists, Types of Engineering, The Different Functions of Engineers, Our Technological World, New Technologies, Data mining, Environmental Issues (Air, Water and Soil Pollution).

Practice:

Practice and reinforcement of grammatical structures and lexical content required by the curriculum; further practice and systematic development of all language skills (listening, speaking, reading and writing).

Literature:

Recommended:

1. E. Nikolić, English Language 3a – A Selection of texts with lexical exercises and communicative activities.
2. E. Nikolić, Engleski jezik 3: Grammar Guide and Practice, Univerzitet u Beogradu, Tehnički fakultet u Boru, 2020.

Ancillary:

1. J. Eastwood, Oxford Practice Grammar (with answers), Oxford University Press, 2006.
2. R. Murphy, English Grammar in use (3rd edition), Cambridge University Press, 2004.

Number of classes per week	**Lectures: 1**	**Practice classes: 1**	**Study research work:**	**Other forms of teaching:**

Teaching methods

Eclectic (combined) method including the principles and techniques of different methods with a focus on communicative approach. Teaching modes: frontal, individual, group/team and pair work.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	20
Exercise attendance	5	Oral part of the final exam*	40
Colloquium exam/s	30		
Term paper			

*The prerequisite for taking the oral part of the exam is earning a minimum of 25 points in the midterm and written part of the final exam.

Study program: Metallurgical Engineering

Course: THEORY OF HYDRO AND ELECTROMETALLURGICAL PROCESSES

Lecturer/s: **Dr. Vesna Grekulović, full professor and Dr. Milan Gorgievski, associate professor**

Status of the course: Elective for the study program Metallurgical Engineering (Module: Extractive metallurgy)

ECTS: 8

Prerequisite: Required knowledge in physical chemistry and metallurgical thermodynamics

Course goals: The aim of the course is to acquire the necessary knowledge in the field of hydro and electrometallurgical processes necessary as a basis for other expert metallurgical subjects, primarily metallurgy of non-ferrous metals, metallurgy of rare metals, hydrometallurgy and wastewater.

Learning outcomes: Students need to prevail the theoretical knowledge necessary for independent research in the field of hydro and electrometallurgy, and to be familiar with the latest achievements in the field of the theory of hydrometallurgical and electrometallurgical processes.

Course description:

Lectures:

Physical - chemical basis of hydro and electrometallurgical processes. Theoretical principles of the leaching process of various materials and leaching equipment. Theoretical basis for concentration and purification processes of metal ions from the solution - ion exchange, solvent extraction and adsorption - desorption. Application of natural adsorbents (biosorbents) for the removal of metal ions from aqueous solutions. Methods for separating the metal compound from the solution. Methods for separating metals from solution - chemical reduction and cementation. The most important hydrometallurgical processes. Thermodynamics of electrometallurgical systems. Conducting electricity through electrolyte solutions. Chemical effect of direct current. Kinetics of electrode processes. Theoretical aspects of electrolysis of solution and melt.

The most important anode and cathode processes in metallurgy (electrolytic separation and metal refining, electrowinning of metal powders, oxides and other products, corrosion and passivation of metals, direct electrochemical oxidation of sulfides).

Practice:

Laboratory exercises related to the determination of the mechanism and kinetics of the leaching process, purification and enrichment of the solutions, and obtaining metals and metal compounds by different chemical and electrochemical methods.

Literature:

Recommended:

1. M. Rajčić-Vujasinović, V. Grekulović, Teorija hidro i elektrometalurških procesa, TF Bor, 2017. (*in Serbian*)

2. N. Pacović, Hidrometalurgija, ŠRIF, Bor, 1980. (*in Serbian*)

3. M. Rajčić-Vujasinović, V. Zlatković, Teorija hidro i elektrometalurških procesa, Praktikum za vežbe, TF Bor, 2001. (*in Serbian*)

Ancillary:

1. K. I. Popov, S. S. Đokić, B. N. Grgur, Fundamental aspects of electrometallurgy, Kluwer Academic Publishers, New York, Boston, Dordecht, London, Moscow, 2002.

2. C. K. Gupta, Chemical Metallurgy, Wiley-Vch Verlag GmbH and Co, 2003.

3. F. Habashi, A Textbook of Hydrometallurgy, Metallurgy Extractive, Quebec, Enr., 1993.

4. J. O`M. Bockris, Modern Aspects of Electrochemistry, Plenum Press, New York, 1973.

5. A. Despić, Osnove elektrohemije 2000, Zavod za udžbenike, Beograd, 2003. (*in Serbian*)

Number of classes per week	**Lectures: 3**	**Practical classes: 1**	**Study research work:**	**Other forms of teaching: 2**

Teaching methods

Lectures with interactive discussions; experimental exercises; seminar work and presentation; consultation.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	
Exercise attendance	10	Oral part of the final exam	60
Coloquium exam/s	2x10 = 20	.....	
Term paper			

Study program: Metallurgical Engineering

Course: HEAT TREATMENT

Lecturer/s: dr Uroš Stamenković, assistant professor

Status of the course: Elective subject for the students in the second semester of the third year

ECTS: 8

Prerequisite: Requires knowledge of Physical chemistry and Physical metallurgy

Course goals: Goal of this course is to provide basic knowledge of the main methods of heat treatment of metals and alloys.

Learning outcomes: Outcome of this course is to gain the necessary knowledge for studying different processes and technologies in the field of processing metallurgy and metallic materials.

Course description:

Lectures:

Introduction to heat treatment. *History of heat treatment development. Heat treatment of metals and alloys.*

Thermodynamics of phase transformations. ***Annealing***. *Annealing without phase transformations. Annealing with phase transformations. Annealing of steel. Annealing of cast iron. Annealing of nonferrous alloys.* **Quenching**. *Quenching without polymorphism. Quenching with polymorphism. Characteristics of martensitic transformation for carbon steel. Thermodynamics, mechanism and kinetics of martensitic transformation. Thermal stabilization of austenite. Change of the properties of alloys with martensitic structure. Thermoelastic martensitic transformation. Shape memory effect. Bainite transformation. Mechanism and kinetics of bainite transformation.* ***Aging***. *Structural changes, thermodynamics and kinetics of aging. Changes in alloy properties after aging. Stress relieving.* ***Stress relieving of steel***. *Structural changes and processes after stress relieving. Change in properties of steel after stress relieving. Stress relief brittleness.* ***Case hardening***. *Basic processes in case hardening. Diffusion in case hardening processes. Mechanisms of diffusional layer forming. Types of case hardening. Carburization. Nitriding. Carbonitriding. The rest of the case hardening processes. Surface quenching. Heat treatment defects and their remedies. Equipment for heat treatment.*

Practical studies: *Laboratory exercises that follow the presented materials in lectures.*

Literature:

Recommended:

1. W.D. Callister, Fundamentals of Materials Science and Engineering: An Integrated Approach, 2nd ed., John Wiley and Sons, New Jersey, 2004.
2. G. Krauss, M. A. Grossmann, Principles of Heat Treatment of Steel, Metal Park Ohio, American Society for Metals, Ohio, 1980

Ancillary:

1. G.E. Totten, Steel heat treatment – Equipment and process design, CRC Press, Taylor & Francis Group, USA, 2007.

Number of classes per week	**Lectures: 3**	**Practical classes: 3**	**Study research work: /**	**Other forms of teaching: /**

Teaching methods: Lectures and laboratory exercises.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	
Exercise attendance	**40**	Oral part of the final exam	**60**

Study program: Metallurgical Engineering

Course: PHYSICAL METALLURGY 2

Lecturer/s: Ivana Markovic, Associated Professor

Status of the course: Mandatory subject of the Metallurgical Engineering study program

ECTS: 6

Prerequisite: Required knowledge of Physical Metallurgy 1

Course goals: Providing basic knowledge in the field of heat treatment of steel, metallography, phase diagrams and heat treatment of non-ferrous metal alloys.

Learning outcomes:

Acquiring the theoretical knowledge for successfully following classes in higher years of study

Course description:

Lectures:

Thermal treatment of steel; Phase transformations during heating of steel; Phase transformations during non-equilibrium cooling of steel; Normalization; Soft annealing; Recrystallization annealing; Tempering; Surface strengthening; Release of steel; Improvement of steel; Impurities of iron; Alloy steels; Steels with silicon, manganese, nickel, chromium, chromium and nickel; High-speed steels and hard metals; Cast iron, modified and tempered cast iron; Copper; Interaction of copper with alloying elements and impurities; Copper for electrotechnical purposes; Brass; Special brasses; Tin bronzes; Aluminum bronzes; Lead bronzes; Beryllium bronzes; Silicon bronzes; Manganese bronzes; Microalloyed copper; Low-alloy bronzes with high electrical and thermal conductivity; Copper - nickel alloys; Aluminum; Non-age hardening aluminum alloys for deformation; Aging-hardening aluminum alloys for deformation; Aluminum alloys for casting; Magnesium; Magnesium alloys for deformation; Magnesium alloys for casting; Titan; Titanium alloys; Zinc; Zinc alloys for casting; Zinc alloys for deformation; Anti-friction zinc alloys; Zinc alloys for soldering; Lead, tin and their alloys; Bearing alloys; Low melting alloys; Soft solders.

Practice:

Theoretical lectures are followed by laboratory exercises in the field of metallographic testing of various alloys.

Literature:

Recommended:

1. D. Marković, Fizička metalurgija, Autorizovana predavanja, Tehnički fakultet u Boru, 2013.

2. H. Šuman, Metalografija, Tehnološko-metalurški fakultet, Beograd, 1989.

Ancillary:

1. R. Abbaschian, L. Abbaschian, R. E. Reed-Hill, Physical Metallurgy Principles, Cengage Learning, 2009.

2. A.M. Russell, K. L. Lee, Structure-Property Relations in Nonferrous Metals, John Wiley & Sons, Inc, 2005.

3. A. Kumar Sinha, Physical Metallurgy Handbook, McGraw-Hill, 2003.

4. H. K. D. H. Bhadeshia, R. W. K. Honeycombe, Steels - Microstructure and Properties, Elsevier Butterworth-Heinemann, 2006.

5. R. A. Higgins, Engineering Metallurgy, Part I - Applied Physical Metallurgy, Arnold, 1999.

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

Teaching methods

Lectures, exercises-practical teaching, preparation of a term paper with a consulting approach to independent work students.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	
Exercise attendance		Oral part of the final exam	70
Coloquium exam/s		Practical lectures	30
Term paper			

Study program: Metallurgical Engineering

Course: HEAT TECHNIQUE AND FURNACES IN METALLURGY

Lecturer/s: Dr. Milan Gorgievski, associate professor

Status of the course: Compulsory

ECTS: 8

Prerequisite: Knowledge in Metallurgical thermodynamics, Theory of pyrometallurgical processes and Metallurgical operations is required.

Course goals: Introducing students to the basic mechanisms of heat transfer, fuels and combustion, different types of refractory materials, with the operation principles of traditional and new types of furnace aggregates, as well as the basics of the heat balance calculations in extractive and processing metallurgy.

Learning outcomes: Students should have the necessary knowledge to calculate the thermal balance of metallurgical processes in a number of furnace aggregates, based on the material balance of the process under consideration, the characteristics of refractory materials, the applied equipment and the heat transfer mechanism.

Course description:

Lectures:

Basic concepts and initial thermodynamic settings. Basics of heat transfer mechanisms. Conduction. Convection. Heat exchange by radiation. Non-stationary heat conduction. Types and characteristics of fuel. Calculation of the combustion process of solid, liquid and gas fuel. Basics of combustion theory and combustion control in industrial conditions. Refractory materials and furnace lining. Heat characteristics of furnace linings. General settings of the theory of furnaces. Thermodynamic and kinetic bases of furnace operation. Basics of the furnace thermal work calculations. Connections between the heat and material balance and calculation of the furnace batch. Typical conditions of the furnace thermal work and furnaces classification. Dryers. Furnaces for roasting, sintering and calcination. Blast furnaces-shaft furnaces. Converters. Reverberatory furnaces. Electric furnaces. Induction furnaces. Vacuum furnaces. New type of furnaces for melting and converting. Fire refining furnaces. Furnaces for melting of non-ferrous metals and their alloys. Furnaces for the production of rare metals and semiconductors. Furnaces for the production of hard alloys and refractory metals.

Practice:

Exercises, Other forms of teaching, Study research work. Calculation exercises follow the lectures.

Literature:

Recommended:

1. Ivan Mihajlović, Toplotna tehnika i peći u metalurgiji, Autorizovana predavanja, Bor, 2012. (*in Serbian*)
2. T. Volkov-Husović, K. Rajić, Metalurške peći, Beograd, 2010. (*in Serbian*)
3. T. Volkov-Husović, Vatrostalni materijali, svojstva i primena, Beograd, 2007. (*in Serbian*)
4. T. Volkov-Husović, K. Rajić, Goriva i sagorevanje, Beograd, 2008. (*in Serbian*)
5. Nikola Colović, Toplotna tehnika, Tehnički fakultet Bor, 1985. (*in Serbian*)
6. Nikola Colović, Peći u metalurgiji, Tehnički fakultet Bor, 1985. (*in Serbian*)

Ancillary:

1. 3. J. Duraković, Sagorevanje goriva, Zbirka zadataka sa teorijom, Zenica, 2007. (*in Serbian*)
2. Z. Popović, K. Raić, Energetika metalurških peći, Zbirka rešenih zadataka, TMF, Beograd, 1986. (*in Serbian*)
3. Z. Popović, K. Raić, Peći i projektovanje u metalurgiji, Zbirka rešenih zadataka, TMF, Beograd, 1988. (*in Serbian*)

Number of classes per week	**Lectures: 3**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching: 1**

Teaching methods

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	20
Exercise attendance	5	Oral part of the final exam	20
Coloquium exam/s	20+20	.....	
Term paper	10		

Study program: Engineering Management, Technological Engineering, Mining Engineering, Metallurgical Engineering

Course title: ENGLISH LANGUAGE 3b

Lecturer: Enisa S. Nikolić

Status of the course: Compulsory for Engineering Management, Technological Engineering, Mining Engineering, Metallurgical Engineering.

ECTS: 2

Prerequisite: Pre-intermediate to intermediate level of language proficiency.

Course goals: Further development of students' language competence in academic and professional contexts, which implies the development of all language skills. Introducing grammatical structures and professional lexis related to the study programs taught at the Technical Faculty in Bor so that students can use professional literature and communicate in English (in written and oral form).

Learning outcomes: Students have mastered specific vocabulary, grammatical structures and language functions characteristic of academic and professional contexts and, to a greater or lesser extent, are able to: independently use professional literature and translate scientific and professional texts of various levels of complexity, present and discuss the topics that have been dealt with in classes and to express themselves in short written forms.

Course description:

Lectures:

Grammar points: Conditionals (all three types); Reported Speech (Sequence of Tenses-Statements); Infinitive vs. -ing form; Participles used adjectivally and in reduced relative clauses; Word formation: common prefixes and suffixes; Linking words 2;

Language functions: Summarizing, Comparing and Contrasting, Sequencing/ Ordering, Problem solving, Defining things, Talking about cause and effect.

Topics: Sustainable Solutions: Recycling, Going Green, Corporate Social Responsibility; The World of Management: Management Functions, Management Levels in an Organization, Production Management; Safety at Work: Importance of workplace safety, Mine Safety, Lab Safety Rules; Presenting your Ideas: Tips for giving presentations.

Practice:

Practice and reinforcement of grammatical structures and lexical content required by the curriculum; further practice and systematic development of all language skills (listening, speaking, reading and writing).

Literature:

Recommended:

1. E. Nikolić, English Language 3a – A Selection of texts with lexical exercises and communicative activities.
2. E. Nikolić, Engleski jezik 3: Grammar Guide and Practice, Univerzitet u Beogradu, Tehnički fakultet u Boru, 2020.

Ancillary:

1. K. Paterson, amp; R. Wedge, Oxford Grammar for EAP, Oxford University Press, 2013.
2. P. Emerson, Business Grammar Builder, Macmillan Publishers Limited, Oxford, 2002.

Number of classes per week	**Lectures: 1**	**Practice classes: 1**	**Study research work:**	**Other forms of teaching:**

Teaching methods

Eclectic (combined) method including the principles and techniques of different methods with a focus on communicative approach. Teaching modes: frontal, individual, group/team and pair work.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	20
Exercise attendance	5	Oral part of the final exam	40
Colloquium exam/s	30		
Term paper			

* The prerequisite for taking the oral part of the exam is earning a minimum of 25 points in the midterm and written part of the final exam.

Study program: Metallurgical Engineering, Engineering Management

Course: Environmental Management

Lecturer/s: Dr. Milovan Vuković, full professor

Status of the course: Elective for 4th grade students of Engineering management - modul Business management and students of Metallurgical Engineering - moduls Extractive Metallurgy

ECTS: 4

Prerequisite: Prior knowledge of the basics of management and company organization

Course goals: The purpose of this course is to acquaint students with the theory and practice of solving problems in the field of protection environment. Students will learn about the importance of environmentally responsible behavior in everyday life and protecting biodiversity and natural resources. Also, this subject strives towards mastering the techniques and skills necessary to solve environmental problems and find sustainable solutions in the business.

Learning outcomes: This course is made up of theoretical lectures whose aim is to acquaint students with different tasks and possible situations that occur in the field of environmental protection. During the lecture, the teacher points to environmental management's nature, task, and role, with special reference to sustainable development. Also, the occurrences and influences of numerous professions in environmental management are considered. The subject characterizes an interdisciplinary approach emphasizing some of the most important ways of making decisions and useful tools in environmental management. The program also provides specific knowledge necessary to perform professional tasks.

Course description:

Lectures:

1. Introduction to environmental management; 2. General principles of sustainability and environmental protection; 3. Classification of natural resources - Atmospheric and climate changes; 4. Water resources and land; 5. Human influence activities on the quality of the environment; 6. Concepts of environmental management; 7. Standard, monitoring, modeling, and control; 8. Environmentally responsible business and industrial companies as a target group; 9. Pollution and waste management; 10. Environmental policy: conflicts, cooperation, and ethical issues; 11. Global environmental challenges.

Literature:

Recommended:

1. Barrow, C. J. (2006). *Environmental Management for Sustainable Development*. 2nd Edition, London/New York: Routledge,

Ancillary:

2. Murali Krishna, I. V, Manickam, Valli (2017). *Environmental Management Science and Engineering for Industry*, 1st Edition. 2017. Elsevier
3. Voza, D. (2022). *Environmental managemen*t. supplementary material, e-version.

Number of classes per week	**Lectures: 2**	**Practical classes: 0**	**Study research work: /**	**Other forms of teaching: /**

Teaching methods

Ex-cathedra lectures and case studies through work in workshops

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**10**	Written part of the final exam	**60**
Exercise attendance	**/**	Oral part of the final exam	
Coloquium exam/s	**20**	.....	
Term paper	**10**		

Study program: Metallurgical Engineering

Course: FUNDAMENTALS OF THE EXTRACTIVE METALLURGY

Lecturer/s: Dr. **Nada Štrbac, full professor**

Status of the course: Elective for the study program Metallurgical Engineering and Elective subject for study program Mining Engineering

ECTS: 6

Prerequisite: Knowledge in Physical chemistry and Mineralogy is required

Course goals: The objective of the course is transfer to students basic knowledge in the field of metal production from primary and secondary raw materials of ferrous and non-ferrous metallurgy, as a significant industrial branch.

Learning outcomes: After completing the course, students have the necessary knowledge on the basis of extractive metallurgy of iron and steel, non-ferrous and rare metals.

Course description:

Lectures:

The concept and division of metallurgy. Metal properties. Basic characteristics of pyrometallurgical, hydrometallurgical and electrometallurgical processes. Metallurgical slags. Refractory materials. Metallurgical fuels. General concepts of technical iron. Classification of iron. Classification of the iron production processes. Raw materials for the production of iron and their preparation. Production of iron in a blast furnace. Manufacturing of iron by other methods. General terms about steel. Classification of steel. Classification of the steel production processes. Raw materials and materials for the steel production. An overview of the processes for the steel production.

Basics of extractive metallurgy of non-ferrous and rare metals (copper, nickel, aluminum, lead, zinc, vanadium, molybdenum, uranium and titanium). Classification of non-ferrous and rare metals. Basic raw materials. Review of the technological procedures for obtaining each metal separately.

Metallurgy of secondary raw materials. Processing of secondary raw materials, collection, sorting, cleaning, melting, refining. Metals and alloys obtained from secondary raw materials.

Environmental protection in extractive metallurgy. Problems of purification of gases, wastewaters and treatment of metallic slags.

Literature:

Recommended:

1. N. Štrbac, Osnovi ekstraktivne metalurgije, Autorizovana predavanja, TF Bor, 2015. *(in Serbian)*

2. F. Habashi, Principles of extractive metallurgy, Laval University, Quebec, Canada, 2008.

Ancillary:

1. R.Vračar, Teorija i praksa dobijanja obojenih metala, SIMS, Beograd, 2010. *(in Serbian)*

2. S.Muhamedagić,, Metalurgija gvožđa, Famultet za metalurgiju i materijale, Zenica, 2005. *(in Serbian)*

3. M. Gojić, Metalurgija čelika, Denona, Zagreb, 2005. *(in Serbian)*

4. B. Đurković, D. Đurković, Metalurgija retkih metala, Tehnološko-metalurški fakultet, Beograd, 1991. *(in Serbian)*

5. Ž. Kamberović, D. Sinadinović, M. Korać, Metalurgija zlata i srebra, SIMS, Beograd, 2007. *(in Serbian)*

6. T.Volkov Husović, Vatrostalni materijali, svojstva i primena, SIMS, Beograd, 2007. *(in Serbian)*

7. T.Volkov Husović, K. Raić, Goriva i sagorevanje, SIMS, Beograd 2008. *(in Serbian)*

Number of classes per week	**Lectures: 2**	**Practical classes:**	**Study research work:**	**Other forms of teaching:**

Teaching methods

Lectures are organized on an interactive basis, with the development of practical examples through group and individual work.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	
Exercise attendance		Oral part of the final exam	60
Coloquium exam/s	10	.....	
Term paper	20		

Study program: Metallurgical Engineering

Course: FUNDAMENTALS OF PROCESSING METALLURGY

Lecturer/s: Dr. Saša Marjanović, associate professor, Dr. Uroš Stamenković, assistant professor

Status of the course: Elective subject for the students in the second semester of the third year

ECTS: 6

Prerequisite: Basic knowledge of metal materials and metal testing knowledge

Course goals: Providing basic knowledge about concepts in the field of metal and alloy processing by casting, plastic processing, thermal treatment and sintering

Learning outcomes: Getting basic theoretical knowledge of shaping metals by technological processes present in processing metallurgy

Course description:

Lectures:

Basic terms in foundry. Division of foundry according to the type of cast, type and purpose of the product.

Preparation of casting alloys. Furnaces and aggregates used in foundries. Impact of the quality of the raw materials on casting process and the quality of the castings. Casting in sand molds. Technology of making molds and cores. Casting in metal molds. Basic concepts of the casting system. Casting characteristics. Alloys of heavy non-ferrous metals - scope of application. Casting alloys of light metals (aluminum, magnesium) and field of application. Special casting methods - basic concepts. Basic types of plastic processing, rolling, forging, extruding pressing, drawing. The first law of plasticity. Grip of metals by rollers. Devices and aggregates that are used in plastic processing. Classification of products obtained by plastic processing. Product quality, the influence of plastic deformation on the mechanical and technological characteristics of the product. The role and importance of thermal processing. Types of thermal processing. Devices and aggregates for thermal treatment. Chemical thermal treatment of steel. General terms from sintermetallurgy. Significance and scope of application of products obtained by sintering. Obtaining metal powders. Obtaining metal oxides. Quality of powders. Sintering-shaping pieces. Thermal processing of sintered form. Plastic processing of sintered pieces.

Practical studies: *Laboratory exercises that follow the presented materials in lectures.*

Literature:

Recommended:

1. J. Campbell, Complete Casting Handbook: Metal Casting Processes, Metallurgy, Techniques and Design, Butterworth-Heinemann, USA, 2015
2. W.F. Hosford, R.M. Caddell, Metal Forming – Mechanics and Metallurgy, Cambridge University Press, UK, 2007

Ancillary:

1. Lj. Ivanić, Livarstvo, Bor, 2000. (in Serbian)
2. M. Pešić, B. Mišković, V. Milenković, Prerada metala u plastičnom stanju, TMF, Beograd, 1992. (in Serbian)

Number of classes per week	**Lectures: 2**	**Practical classes: /**	**Study research work: /**	**Other forms of teaching: /**

Teaching methods: Lectures and laboratory exercises.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**10**	Written part of the final exam	**20**
Exercise attendance		Oral part of the final exam	**60**
Coloquium exam/s	**10**	.....	

Study program: Metallurgical Engineering

Course: METALLURGY OF IRON

Lecturer/s: Dr. Ljubiša Balanović, associate professor

Status of the course: Compulsory for study program Metallurgical Engineering (Module: Extractive Metallurgy)

ECTS: 8

Prerequisite:

Required knowledge of the theory of pyrometallurgical processes, heat engineering and furnaces in metallurgy, and metallurgical operations.

Course goals:

The objective of the course is to familiarize students with raw materials and materials for iron making, theoretical foundations and the technological process of iron making in the blast furnace, as well as new processes in the production of iron.

Learning outcomes:

Students have the necessary theoretical and technological knowledge in the field of iron metallurgy and have been trained to calculate the material and heat balance in the processes of iron making.

Course description:

A brief overview of the historical development of iron metallurgy. Iron. Classification. Basic raw materials and materials for the production of iron. Agglomeration of iron ores and concentrates. Pelletizing. Extraction of iron in a blast furnace. Process diagram and blast furnace profile. Evaporation of moisture and decomposition of carbonates. Reduction of oxides in a blast furnace. Formation of iron. Formation of slag. Behavior of sulfur in a blast furnace. Heat exchange in a high furnace. Movement of mixtures and gases in a blast furnace. Practical work of the blast furnace. Intensification of the high-flow process. Auxiliary devices. Mathematical models and automation of blast-furnace operation. New processes in the production of iron.

Literature:

Recommended:

1. B. Trujic, N. Mitevska, Metalurgija gvožđa, Institut za bakar, Bor, 2007. (*in Serbian*)
2. Б. Божић, Металургија гвоћа, БИГС, Београд, 1973.
3. С. Мухамедагић, Металургија гвожђа, Висока пећ, Fakultet za metalurgiju i materijale, Zenica, 2005.
4. B. Trujić, Savremeni proračuni u metalurgiji gvožđa, Institut za bakar, Bor, 2007. (*in Serbian*)

Ancillary:

1. A. Ghosh, A. Chatterjee, Iron making and steelmaking: Theory and practice, PHI Learning Pvt. Ltd., 2008.
2. K. Meyer, Pelletizing of Iron Ores, Springer-Verlag, Berlin – New York, 1980.
3. В.В. Полтавец, Доменное производство, Металлургија, Москва, 1971. (*in Russian*)
4. Е.Ф. Вегман, Металургија чугуна, Металургија, Москва, 1981. (*in Russian*)
5. C. Bodsworth, H.B.Bell, Physical Chemistry of Iron and Steel Manufacture, Second Edition, Longman Group Ltd., London, 1972.

Number of classes per week	**Lectures: 3**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching: 1**

Teaching methods

Lectures and calculation exercises.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	**30**
Exercise attendance	**5**	Oral part of the final exam	**30**
Coloquium exam/s	**15+15**	.....	
Term paper			

Study program: Metallurgical Engineering

Course: METALLURGY OF THE HEAVY NON-FERROUS METALS

Lecturer/s: Dr. Nada Štrbac, full professor, Dr. Ljubiša Balanović

Status of the course: Compulsory for study program Metallurgical Engineering (Module: Extractive Metallurgy)

ECTS: 5

Prerequisite:

Knowledge in Theory of pyrometallurgical processes, Heat technique and furnaces in metallurgy and Theory of hydro and electrometallurgical processes is required

Course goals:

The objective of the course is to familiarize students with raw materials and materials for process of production heavy non-ferrous metals, and with modern technological processes for metallurgical production of copper, nickel, lead, zinc, mercury, cadmium, antimony, indium, precious metals.

Learning outcomes:

Students have the necessary theoretical and technological knowledge in the field of metallurgy of non-ferrous metals and are educated to calculate the material and thermal balance of the metallurgical processes used to obtain them.

Course description:

Lectures:

The basic classification of non-ferrous metals. The term and definition of ore. Foundations of non-ferrous metals in the world. Metallurgy of heavy non-ferrous metals - modern methods of process for production and refining. Metallurgy of copper, nickel, lead, zinc, mercury, cadmium. Metallurgy of precious metals - gold, silver and platinum metals.

Practice:

Calculation and laboratory excercises follow the lectures.

Literature:

Recommended:

1. Ž. Živković, V. Savović, Fizičko-hemijske osnove procesa topljenja i konvertorovanja, Bor, Bakar, 1994. (in Serbian)
2. R. Vračar, Metalurgija cinka, Naučna knjiga, Beograd, 1995. (in Serbian)
3. R. Vračar, Metalurgija olova, Naučna knjiga, Beograd, 1995. (in Serbian)
4. R. Vračar, Teorija i praksa obojenih metala, Beograd, 2010. (in Serbian)
5. N. Štrbac, Ž. Živković, I. Mihajlović, Zbirka zadataka iz metalurgije obojenih metala, TF Bor, 2002. (in Serbian)
6. N. Štrbac, Ž. Živković, D. Minić, D. Petković, Metalurgije obojenih metala – praktikum za vežbe, Bor, 2004. (in Serbian)
7. R. Vračar, Ž. Kamberović, D. Sinadinović, V. Savović, S. Stopić, K. Cerović, "Proračuni u metalurgiji obojenih metala", Bakar-Bor, 2000. (in Serbian)

Ancillary:

1. M.E. Schlesinger, M.J. King, K.C. Sole, W. G. Davenport, Extractive metallurgy of copper, Fifth edition, Oxford, UK: Perfamon press an imprint of Elsevier science, 2011.
2. W.G.L. Devenport, D.M. Jones, M.J. King, E.H. Partelpoeg, Flash Smelting: Analysis, Control and Optimization, Second Edition, Wiley-TMS, 2004.
3. F. Habashi, Extractive Metallurgy Today – Problems and Progress, Laval University, Canada, 2000.
4. F. Habashi, Principles of Extractive Metallurgy, Vol.1, General Principles, Gordon and Breach, Science Publishers Ltd., New York, 1969.
5. F. Habashi, Principles of Extractive Metallurgy. Volume 3: Pyrometallurgy, Gordon & Breach, Science Publishers Ltd., New York, 1986.
6. F. Habashi, Handbook of extractive metallurgy, VCH Verlagsgesellschaft mbH, Awiley Company, 1997.
7. B. A. Wills, T. J. Napier-Munn, Mineral Processing Technology, Elsevier Science and Technology Books.

8. S. Seetharman, Fundamentals of Metallurgy, Woodhead Publishing Limited and Crc Press LLC, 2005.				
Number of classes per week	**Lectures: 3**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching: 1**
Teaching methods Lectures, calculation and experimental exercises				
Knowledge evaluation (maximum 100 points)				
Pre-examination obligations	Points	**Final exam**		Points
Lecture attendance	**5**	Written part of the final exam		**30**
Exercise attendance	**5**	Oral part of the final exam		**30**
Coloquium exam/s	**15+15**	.....		
Term paper				

Study program: Metallurgical Engineering

Course: METALLURGY OF THE RARE METALS

Lecturer/s: Dr. Nada Štrbac, full professor

Status of the course: Compulsory

ECTS: 8

Prerequisite: Knowledge in Chemistry, Theory of pyrometallurgical processes and Theory of hydro and electrometallurgical processes is required.

Course goals: The objective of the course is to transfer knowledge from metallurgy of rare metals to students, which is a very important field of industry, thanks to the production of new materials with special properties, based on rare metals.

Learning outcomes: Students have the necessary theoretical and technological knowledge in the field of metallurgy of rare metals and are educated to calculate the material and thermal balance of the metallurgical processes used for obtaining them.

Course description:

Lectures:

State and tendencies in the field of rare metals metallurgy. Basic properties of metals. Occurrence and classification of rare metals. Basic processes and methods for obtaining rare metals. Processes and methods of metallurgical preparation and concentration of rare metals. Processes and methods for obtaining rare metals. Processes and methods for refining rare metals. Metallurgy of rare metal powders. Smelting and casting of rare metals. Metallurgy of refractory rare metals. Basic properties, field of application, basic characteristics of raw materials. Methods for processing raw materials and obtaining metals: molybdenum, rhenium, vanadium, tungsten, zirconium, hafnium, titanium, niobium and tantalum. Metallurgy of light rare metals. Basic properties, field of application, basic characteristics of raw materials. Methods for processing raw materials and obtaining metals: rubidium, cesium, beryllium. Metallurgy of metals from the group of lanthanides. Basic properties, field of application, basic characteristics of raw materials. Procedures for processing raw materials and obtaining oxides and metals. Metallurgy of radioactive metals. Basic properties, field of application, basic characteristics of raw materials. Procedures for processing raw materials and obtaining technical concentrates, nuclear pure salts and fuel elements. Uranium and thorium. Extraction of rare metals from secondary raw materials. Ecological basics in the processing of primary and secondary raw materials in the production of rare metals.

Practice:

Calculation and laboratory exercises.

Literature:

Recommended:

1. N. Štrbac, Autorizovana predavanja, TF Bor, 2016. *(in Serbian)*

2. B. Đurković, D. Đurković, Metalurgija retkih metala, Tehnološko – metalurški fakultet, Beograd, 1991. *(in Serbian)*

Ancillary:

1. N.Krishnamurthy, C.K.Gupta, Extractive Metallurgy of Rare Earths, CRC Press, Florida, 2015.

2. A.N.Zelikman, O.E.Krein, G.V.Samsonov, Metallurgy of Rare Metals (2nd edition), Metalurgia, Moskva, 1966. *(in Russian)*

3. Г.Е. Каплан, Г.Ф. Силина, Ју. И. Остроушко, Електролиз в металлургии редких металлов, Научнотехническое издателство литератури, Москва, 1963. *(in Russian)*

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

Teaching methods

Teaching is organized on an interactive basis, and includes: lectures, experimental and calculation exercises. Students also do the independent work and present their results through seminar papers.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	
Exercise attendance	10	Oral part of the final exam	40
Coloquium exam/s	20	.....	
Term paper	20		

Study program: Metallurgical Engineering

Course: METALLURGY OF THE LIGHT METALS

Lecturer/s: Dr. Nada Štrbac, full professor, Dr. Ljubiša Balanović, associate professor

Status of the course: Compulsory for study program Metallurgical Engineering (Module: Extractive Metallurgy)

ECTS: 8

Prerequisite:

Knowledge in Theory of pyrometallurgical processes, Heat technique and furnaces in metallurgy and Theory of hydro and electrometallurgical processes is required.

Course goals:

The aim of the course is to introduce students to raw materials and materials for process of production light non-ferrous metals, as well as to modern technological processes of metallurgical production of aluminum, magnesium, sodium, potassium, calcium and barium.

Learning outcomes:

Students have the necessary theoretical and technological knowledge in the field of metallurgy of non-ferrous metals and are trained to calculate the material and thermal balance of the metallurgical processes used to obtain them.

Course description:

Lectures:

Metallurgy of light non-ferrous metals - modern methods for process of production and refining. Metallurgy of aluminum Metallurgy of magnesium Metallurgy of sodium Metallurgy of potassium Metallurgy of calcium Metallurgy of barium

Practice:

Calculation and laboratory exercises follow the lectures

Literature:

Recommended:

1. R.Vračar, Ž.Živković, Ekstraktivna metalurgija aluminijuma, Naučna knjiga, Beograd, 1994. *(in Serbian)*
2. R.Vračar, Teorija i praksa dobijanja obojenih metala,SIMS,Beograd, 2010. *(in Serbian)*
3. R.Vračar, Metalurgija magnezijuma i legura magnezijuma, Naučna knjiga, Beograd, 1998. *(in Serbian)*
4. N.Štrbac i dr, Zbirka zadataka iz metalurgije obojenih metala, TF Bor Bor, , 2003. *(in Serbian)*
5. N.Štrbac i dr., Praktikum iz metalurgije obojenih metala, TF Bor. Bor, 2004. *(in Serbian)*

Ancillary:

1. F. Habashi, Extractive Metallurgy Today – Problems and Progress, Laval University, Canada, 2000.
2. F. Habashi, Principles of Extractive Metallurgy, Vol.1, General Principles, Gordon and Breach, Science Publishers Ltd., New York, 1969.
3. G.Solymar, Light metals, Elsevier, London, 2003.
4. I.A.Troickoj, V.A.Zeleznov, Metalurgija aluminija, Metalurgija, Moskva 1984. *(in Russian)*

Number of classes per week	**Lectures: 3**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching: 1**

Teaching methods

Lectures, calculation and experimental excercises

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	**30**
Exercise attendance	**5**	Oral part of the final exam	**30**
Coloquium exam/s	**15+15**	.....	
Term paper			

Study program: Metallurgical Engineering

Course: METALLURGY OF STEEL

Lecturer/s: Dr. Dragan Manasijević, full professor, Dr. Milan Gorgievski, assistant professor

Status of the course: : Obligatory subject

ECTS: 5

Prerequisite: Required knowledge of the theory of pyrometallurgical processes, heat engineering and furnaces in metallurgy, and iron metallurgy.

Course goals: The aim of the course is to acquaint students with the principles of steel production and the contemporary technological processes of obtaining steel.

Learning outcomes: Students possess the necessary theoretical and technological knowledge in the field of steel metallurgy and are trained to calculate the material and heat balance in the process of obtaining steel.

Course description:
Definition, properties and types of steel. The influence of impurities on the properties of steel. A brief overview of the historical development of steel metallurgy: Bessemer, Thomas, Open Hearth processes. Theoretical principles of steel production. Basic reactions in steelmaking: Si, Mn, C, S, P in steel. Slag in steel metallurgy. Gases and non-metallic inclusions in steel. Processes for steel production – Basic Oxygen Converter Process, Electric Arc Furnace (EAF) Process. Stainless steelmaking processes. Deoxidation and alloying of steel. Secondary metallurgy. Synthetic slag processing of steel. Desulphurization. Degassing. Control of non-metallic inclusions. Casting of steel and solidification of the ingot. New processes in steel metallurgy.

Literature:

Recommended:

1. D. Manasijević, D. Živković, Metallurgy of steel, Technical faculty in Bor, Bor, 2014. (*in Serbian*)
2. M. Gojić, Metallurgy of steel, Faculty of Metallurgy, Sisak, 2005. (*in Serbian*)
3. M. Gorgievski, D. Manasijević, D. Živković, A collection of tasks from steel metallurgy, Technical faculty in Bor, Bor, 2016. *(in Serbian)*

Ancillary:

1. A.Ghosh and A. Chatterjee, Ironmaking and Steelmaking: Theory and Practice, PHI Learning Pvt. Ltd., 2011.
2. A. Ghosh, Secondary Steelmaking: Principles and Applications, CRC Press, 2001.
3. Turkdogan, E.T., Ironmaking and Steelmaking, 15, 1988.
4. B. Deo, and R. Boom, Fundamentals of Steelmaking Metallurgy, Prentice Hall International, London,1993.

Number of classes per week	**Lectures: 3**	**Practical classes: 2**	**Study research work:**	**Other forms of teaching: 1**

Teaching methods

Lectures, calculation and experimental exercises.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	**30**
Exercise attendance	**5**	Oral part of the final exam	**30**
Coloquium exam/s	**30**	.....	
Term paper			

Study program: Metallurgical Engineering

Course: PROCESSING OF METALS IN A PLASTIC STATE 1

Lecturer/s: dr Saša R. Marjanović, Associate Professor

Status of the course: Compulsory for Module: Processing metallurgy

ECTS: 8

Prerequisite: Necessary knowledge of mathematics, physics and physical metallurgy.

Course goals: The course should enable the student to study the processes that take place in solid metal (alloy) under the influence of stress that cause a change in shape and dimensions with a constant value of the volume, whereby the greatest attention is paid to rolling as the most common method of metal processing in general.

Learning outcomes: The student should become familiar with the processes of metal flow in the solid state and master specific rolling technologies in order to be able to work effectively independently and in a team in this area.

Course description:

Lectures: Correlation of deformation and structural changes in metal. Characteristics of hot and cold plastic deformation. Reinforcement and texture. Recrystallization and fibrous structure. Reinforcement diagrams of metals and alloys. The role of crystal structure defects in plastic deformation processing. Thermomechanical mode of metal processing. Diagrams of recrystallization, equilibrium state, resistance to deformation and plasticity of metals. Technological features and TMR of metal processing. Superplasticity. Rolling of metals and alloys. General scheme of technological process in rolling mills. Division and purpose of semi-finished products. Types of rolling mills. Technological process of rolling blooms, slabs and billets. Preparation of semi-finished products for further processing. Profile rolling. Types of rolling mills. Calibration. Rolling of wire and profiles of small cross-sections. Rolling of sheets and strips. Rolling of seamless pipes. Rolling of balls, banadage and wheels. Problems and errors in valid products.

Practice: Computational and laboratory exercises follow the lectures. Determination of TMR processing for a specific alloy, calibration.

Literature:

Recommended:

1. М. Пешић, Б. Мишковић, В. Миленковић, Прерада метала у пластичном стању, ТМФ, Београд, 1992.
2. Ђ. Дробњак, Физичка металургија, Физика чврстоће и пластичности, ТМФ, Београд, 1990.
3. М. Чаушевић, Обрада метала ваљањем, В. Маслеша, Сарајево, 1985.
4. Б. Перовић, Физичка металургија, МТФ, Подгорица, 1997.

Ancillary:

1. S. H. Talbert, B. Avitzuk, Elementary Mechanics of Plastic Flow in Metal Forming, John Wiley & Sons, 1996.
2. Metal forming - mechanics and metallurgy, William F. Hosford, Robert M. Caddel, 2007.
3. P. I. Poluhin, Tehnologija procesov obrabotki metallov, davleniem, Metallurgija, Moskva, 1988.
4. Б. Мишковић, М. Мишовић, Р. Стефановић, Калибровање ваљака у ваљаоницама челика и обојених метала, Савез инжењера металургије Југославије, ТМФ, Београд, 1997.
5. A. Tselikov, Stress and Strain in Metal Rolling, University Press, L.A., 2003.
6. G. E. Dieter, Mechanical Metallurgy, Mc Graw-Hill, London, 1986.

Number of classes per week	**Lectures: 3**	**Practical classes: 3**	**Study research work: ?**	**Other forms of teaching: ?**

Teaching methods

Lectures and computational exercises are organized on an interactive basis, which, in addition to classic lectures and presentations, includes discussions and active participation of students during classes.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	**20**
Exercise attendance	**5**	Oral part of the final exam	*50*
Coloquium exam/s	**1 x 20 = 20**	.....	
Term paper			

Study program: Metallurgical Engineering,

Course: The foundry

Lecturer/s: : Dr. Srba A. Mladenović, full prof.

Status of the course: Compulsory for Metallurgical Engineering (processing metallurgy modul)

ECTS: 8

Prerequisite: knowledge of physical metallurgy

Course goals: Training students for independent work within the processes that take place in the foundry..

Learning outcomes: Students should learn the basic technology in foundry processes. Mold, model, and core making technologies.

Course Description: A casting. Definition. Basic terms. Projecting the technology of making castings. Models. Core boxes. Materials for making sand-clay, metal, metal-ceramic, and other modern molds. Composition and properties of mortar and core mixtures: physical-mechanical, technological, and exploitative. Natural, semi-synthetic, and synthetic mixtures. Mold and core mixtures with refractory materials. Production of sand-clay molds. The theoretical basis of mold making. Manual and machining mold making. Special types of molds. Modern molds. Gating system. Basic elements. Calculation of dimensions. A riser. Cavities, macro, and micro. Feeders as technological elements. Methods for calculating the dimensions of feeders. The final operations of making sand-clay molds. Methods of strengthening molds and cores. Reassembling of mold parts and casting. Final operations in the production of castings by casting in sand-clay molds and other types of molds. Extraction of the castings. Demolition of sand-clay molds: manual and mechanical. Cast cleaning. Quality, defects, and technical casting control. Casting materials. Classification of metals and alloys for casting: iron alloys and non-ferrous metals. Classification of iron alloys: cast iron and cast steel. Definition, chemical composition, structure. Structural properties of different types of cast iron and steel. Production of cast iron. The technology of remelting process in the cupola, flame, and electric furnaces. Production of high-quality gray cast iron with lamellar, vermicular, and spherical graphite forms. Production of white and tempered cast iron. Production of alloyed types of cast iron.
Lectures:

Practice: *Computational and laboratory exercises follow the lectures.*

Literature:

Recommended:

4. Peter Beeley, Foundry Technology, Butterworth Heinemann, Oxford, 1972

Ancillary:

3. Steve Hurst, Metal Casting: Appropriate Technology in the Small Foundry, Intermediate Technology Publications, 1996

Number of classes per week	**Lectures: 3**	**Practical classes: 3**	**Study research work: ?**	**Other forms of teaching: ?**

Teaching methods

Lectures, exercises, and practical work, organized on an interactive principle, which in addition to classical lectures and presentations includes discussions and active participation of students.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	**20**
Exercise attendance	**15**	Oral part of the final exam	*35*
Coloquium exam/s	**10**	.....	
Term paper	**15**		

Study program: Metallurgical Engineering

Course: SINTERMETALLURGY

Lecturer/s: Ivana Markovic, Associated Professor

Status of the course:

Mandatory subject of the study program Metallurgical Engineering (Module: Processing Metallurgy)

ECTS: 8

Prerequisite: Required knowledge of Physical Chemistry, Physical Metallurgy 1 and 2

Course goals: Introducing the student to the field of sintermetallurgy and characterization of metal powders. Getting to know the basic stages of the sintermetallurgical process and analyzing their influence on the structure and properties of the sintered material.

Learning outcomes:

Students should overcome the theoretical and practical knowledge needed for independent research in the field of sintermetallurgy and be familiar with the latest research in methods for obtaining metal powders, ways of shaping particles and the sintering process.

Course description:

Lectures:

Technologies for obtaining metal powders. Physico-chemical methods of obtaining metal powders: chemical reduction, electrolysis of aqueous solutions or salts of various metals, carbonyl dissociation, thermodiffusion saturation, evaporation and condensation. Mechanical methods of obtaining metal powders: atomization, crushing and grinding, granulation, metal processing by cutting. Characterization of metal powders. Preparation of powders for shaping and compacting processes. Shaping under pressure at room temperature. Shaping by applying pressure at an elevated temperature. Shaping without applying pressure. Sintering of metal powders. Sintering in the solid state. Mechanisms of matter transport during sintering of metal powders. Sintering stages. Sintering in the presence of a liquid phase. Mechanisms of the sintering process in the presence of a liquid phase. Sintering under pressure. Activated sintering. New sintering techniques.

Practice:

Theoretical lectures are followed by laboratory exercises that include testing and characterization of metal powders according to ISO standards for the field of powder metallurgy.

Literature:

Recommended:

1. M. Mitkov, D. Božić, Z. Vujović, Metalurgija praha, BMG, Zavod za udžbenike i nastavna sredstva, Vinča,1998.
2. S. Nestorović, Sintermetalurgija - praktikum, Tehnički fakultet u Boru, 2001.
3. W. Schatt, K.P.Wieters, Metalurgija praha - prerada i materijali, EPMA,1994.

Ancillary:

1. I. Belić, Z. Aćimović Pavlović, Tehnologija izrade delova od metalnog praha, SIMS, 2007.
2.O. Neikov, Stanislav S. Naboychenko, G. Dowson, Handbook of Non-Ferrous Metal Powder, Elsevier, 2009.
3. S.J.L. Kang, Sintering - Densification,Grain Growth, and Microstructure, Elsevier, 2005.

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

Teaching methods

Lectures, exercises-practical teaching, preparation of a term paper with a consulting approach to independent work students.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	
Exercise attendance	15	Oral part of the final exam	45
Coloquium exam/s	2*20=40	Practical lectures	
Term paper			

Study program: Metallurgical Engineering,

Course: Metallurgy of welding

Lecturer/s: : Dr. Srba A. Mladenović, full prof.

Status of the course: Compulsory for Metallurgical Engineering (processing metallurgy modul)

ECTS: 6

Prerequisite: knowledge of physical metallurgy

Course goals: Providing basic theoretical knowledge in the field of welding processes, technologies, and applicable welding procedures.

Learning outcomes: Acquisition of basic theoretical knowledge that is necessary for the study of welding processes and various technologies in areas of welding metal materials.

Course Description: Joint formation in the welding process. Residual stresses and deformations in welded joints. Merger procedures by welding. Electric arc welding. E - welding procedure. Welding in an atmosphere of protective gases - MIG, MAG, TIG. Powder welding. Welding under slag. Electric resistance welding. Special procedures of the welding. Welding metallurgy. The reaction of gases with molten metals. Steel welding. Welding of various materials. Cast iron welding. Welding of nickel and its alloys. Welding of copper and its alloys. Welding of aluminum and its alloys. Welding of titanium and its alloys. Welding of magnesium and its alloys. Weld defects and quality control
Lectures:

Practice: *Laboratory exercises, which include the application of various methods of welding metal materials and analysis of the quality of the weld and the characteristics of the welded joint, follow the material presented in the lectures.*

Literature:

Recommended:

1. J. F. Lancaster, Metallurgy of Welding, Woodhead Publishing, 1999

Ancillary:

Number of classes per week	**Lectures: 2**	**Practical classes: 3**	**Study research work: ?**	**Other forms of teaching: ?**

Teaching methods

Lectures, exercises, and practical work, organized on an interactive principle, which in addition to classical lectures and presentations includes discussions and active participation of students.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	
Exercise attendance	**20**	Oral part of the final exam	*40*
Coloquium exam/s		.....	
Term paper	**40**		

Study program: Metallurgical Engineering

Course: PROCESSING OF METALS IN A PLASTIC STATE 2

Lecturer/s: dr Saša R. Marjanović, Associate Professor

Status of the course: Elective for Module: Processing metallurgy

ECTS: 6

Prerequisite: Necessary knowledge of mathematics, physics and physical metallurgy.

Course goals: The course should enable the student to study solid state metalworking processes such as hot and cold pressing, drawing, forging and deep drawing.

Learning outcomes: The student should become familiar with the processes of forming metal in a solid state and master the specific technologies of pressing, drawing, forging and deep drawing in order to be able to work effectively independently and in a team in this area.

Course description:

Lectures: Pressing of metals and alloys by extrusion. Pressing procedures. Metal flow in the pressing process. Extrusion pressing technology. Starting material for pressing. Assortment of pressed products. Presses and pressing tools. Characteristics of the structure and properties of pressed products. Techno-economic indicators of the extrusion pressing process. Extraction of metals and alloys. Material preparation and drawing tool. The role of lubricants. Assortment of extraction products. General scheme of the technological process. Extraction of wires, rods, pipes and profiles. Drawing machines. Selection and arrangement of draw reductions. Extraction tool. Thermal treatment of products and their quality control. Techno-economic indicators of the extraction process. Forging and forge pressing. Free forging and forging in molds. Forging and pressing technology. Deep drawing.

Practice: Computational and laboratory exercises follow the lectures. Determination of TMR processing for a specific alloy.

Literature:

Recommended:

1. М. Пешић, Б. Мишковић, В. Миленковић, Прерада метала у пластичном стању, ТМФ, Београд, 1992.
2. Б. Мусафија, Обрада метала пластичном деформацијом, Светлост, Сарајево, 1985.
3. М. Пешић, В. Миленковић, Извлачење жица, шипки и цеви, ТК, Београд,, 1965.
4. Д. Гусковић, Б. Станојевић, С. Стевић, Савремени поступци добијања бакарних жица, ТФ, Бор, 1997.

Ancillary:

1. G. E. Dieter, Mechanical Metallurgy, Mc Graw-Hill, London, 1986.
2. Ju. F. Sevakin, Presovanie tjazelyh cvetnyh metallov I splavov, Metallurgija, Moskva, 1989.
3. М. З. Ерманок, Л. С. Ватрусин, Волоцение Цветних металлов, Металлургија, Москва, 1982.
4. Е. И. Семенов, Ковка и стамповка, Масиностроение, Москва, 1983.
5. Composites Forming Technologies, A. C. Long, 2007.
6. A. H. Fritz, G. Schulze, Fertigungstechnic, Springer Verlag, Berlin, 2001.

Number of classes per week	**Lectures: 3**	**Practical classes: 3**	**Study research work: ?**	**Other forms of teaching: ?**

Teaching methods

Lectures, exercises and practical work are organized on an interactive basis, which, in addition to classic lectures and presentations, includes discussions and active participation of students in all elements of teaching.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	**20**
Exercise attendance	**5**	Oral part of the final exam	*50*
Coloquium exam/s	**1x20=20**	.....	
Term paper			

Study program: Metallurgical Engineering

Course: VACUUM METALLURGY

Lecturer/s: Dr. Dragan Manasijević, full professor

Status of the course: : Elective subject (module Extractive Metallurgy)

ECTS: 6

Prerequisite: Required knowledge of metallurgical thermodynamics, heat engineering and furnaces in metallurgy, metallurgical operations, metallurgy of iron and steel, and metallurgy of rare metals.

Course goals: To make students familiar with the application of vacuum in the field of metallurgical production and in the production of modern metallurgical materials, given the wide application and importance of vacuum treatment in modern processes.

Learning outcomes: The outcome of this elective course is to acquaint students with more detailed information on metallurgical processes under vacuum.

Course description:
Basic terms. History of vacuum application in metallurgy. Vacuum classification. Measurement of vacuum. Types of vacuum pumps. Work under vacuum. The influence of vacuum on some important properties of metal and alloys. Theoretical basics of vacuum-metallurgical processes. Thermodynamics of vacuum-metallurgical processes. Vacuum-metallurgy processes kinetics. Application of vacuum techniques in extractive metallurgy. Vacuum technologies in preliminary stages of metallurgical reduction processes. Metal reduction processes under vacuum: carbothermic and metalothermic processes. Refining of metal under vacuum. Separation of the metal by vacuum distillation. Deoxidation and decarburization of the metals under vacuum. Zone melting. Vacuum degassing of metals in liquid and solid state. Plasma deposition of protective coatings.

Literature:

Recommended:

1. D. Manasijevic, Vacuum metallurgy, Authorized lectures, Technical Faculty in Bor, 2014. (*in Serbian*)

Ancillary:

1. O.Winkler, R.Bakish, Vacuum metallurgy, Elesevier Publishing Company, Amsterdam, 1971.
2. A.Choudhury, Vacuum metallurgy, ASM Intl., New York, 1990.
3. A.M.Самарин, Вакуумнаја металургија, ГНТИ, Москва, 1962. (in Rusian)
4. W. Umrath, Fundamentals of Vacuum Technology, Leybold, 1998.

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

Teaching methods

Lectures, calculation and experimental exercises.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**10**	Written part of the final exam	**20**
Exercise attendance	**10**	Oral part of the final exam	**30**
Coloquium exam/s		.....	
Term paper	**30**		

Study program: Metallurgical Engineering

Course: METALLURGY OF THE SECONDARY RAW MATERIALS

Lecturer/s: Dr. Nada Štrbac, full professor

Status of the course: Compulsory for ...; Elective for for study program Metallurgical Engineering (Modul: Extractive metallurgy), Obligatory subject for study program Mining Engineering (Modules: PMS and RTiOR) and Elective subject for study program Technological Engineering (Module: Environmental protection engineering)

ECTS: 6

Prerequisite: Knowledge in general technological disciplines is required.

Course goals: The goal of the course is transferring the knowledge to students in the field that deals with the problem of the formation and processing of secondary raw materials of ferrous and non-ferrous metallurgy.

Learning outcomes: After studying the subject and calculation and experimental exercises, students have the necessary knowledge to calculate the material and thermal balance of metallurgical processes, which are applied in metallurgy of secondary raw materials, as well as theoretical knowledge that enable them to choose the right technology for the processing of secondary raw materials.

Course description:

Lectures:

Raw materials in secondary metallurgy and their usage. Sources of production of secondary raw materials. Classification of secondary raw materials. Determination of resources of secondary raw metal materials. Organization of collection and preparation of metal scrap and waste. Primary treatment: sorting, magnetic separation, separation, cutting, crushing and grinding, degreasing and drying, packing and briquetting, electrostatic separation, etc. Processing of metal waste. Production of secondary copper and copper alloys. Nickel based scrap and waste processing. Processing of secondary lead and alloys. Obtaining tin from secondary raw materials. Collecting, preparation and metallurgical processing of iron scrap. Processing of secondary raw materials containing zinc. Processing of secondary aluminum. Collection, primary treatment of scrap and waste and metallurgical processing of other non-ferrous metals and alloys (Sb, Hg, Co, etc.). Non-metallic waste processing. Hydrometallurgical processing of raw materials containing zinc. Obtaining precious metals from scrap and waste. Ecological bases for processing secondary raw materials. The economic effects of complex processing of secondary raw materials. Perspectives of the development of secondary metallurgy.

Practice:

Laboratory and calculation exercises follow lectures related to raw materials in secondary metallurgy. Independent work.

Literature:

Recommended:

1. N. Štrbac, Autorizovana predavanja, Bor, 2016. *(in Serbian)*

2. I. Ilić, Z. Gulišija, M. Sokić, Reciklaža metaličnih sekundarnih sirovina, ITNMS, Beograd, 2010. *(in Serbian)*

3. M.Vojinović i dr. Prerada otpadnih olovnih akumulatora u ekološki povoljnim uslovima, DIT EP, Bograd, 2004.

Ancillary:

1. I. Ilić i dr., Resursi i reciklaža sekundarnih sirovina obojenih metala, Institut za bakar, Bor, 2002. *(in Serbian)*

2. R.Vračar, LJ. Jakšić, Sekundarna metalurgija olova, Fakultet tehničkih nauka Kosovska Mitrovica, 2001. *(in Serbian)*

4. S.R.Rao, Resource Recovery and Recycling from Metallurgical Wastes, Elsevier, Amsterdam, 2006.

5. И. Хайдуков, Металургија вторичних цветних металов, Москва, Металургија, 1987. *(in Russian)*

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

Teaching methods

Lectures, laboratory and calculation exercises.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	
Exercise attendance	10	Oral part of the final exam	40
Coloquium exam/s		.....	
Term paper	40		

Study program: Metallurgical Engineering

Course: METAL PLATING

Lecturer/s: Dr. Vesna Grekulović, full professor and Dr. Milan Gorgievski, associate professor

Status of the course: Elective for the study program Metallurgical Engineering (Module: Extractive metallurgy)

ECTS: 6

Prerequisite: Required knowledge of the theory of hydro and electrometallurgical processes and metalurgical operations

Course goals: The aim of the course is to acquaint students with theoretical principles and practical methods of metal plating.

Learning outcomes: Training students to independently deal with the processes of obtaining metal coatings at the engineering level, as well as setting the parameters for obtaining the coating of the choice.

Course description:
Lectures:
Types of metal coatings. Theoretical aspects of chemical deposition of metals. Fundamental principles in electrochemistry. Basic electrolysis laws. Types of solutions used in galvanotechnics. Mechanism of precipitation and dissolution of metals. Electro crystallization of metals. Kinetics of precipitation and dissolution of metals. Electrochemical evolution of hydrogen. Anode reactions. Preparation of surface for application of metal coatings. Copper coatings. Nickel coatings. Chromium coatings. Tin coats. Iron coatings. Coatings of precious metals. Coating of alloys. Galvanic coatings on aluminum and its alloys. Metallic coatings obtained by thermic methods. Coatings obtained by diffusion processes. Electrolyte control. Control of metal coatings.
Practice:

Practical classes include laboratory exercises based on the fundamental laws of electrolysis, demonstrate electrochemical evolution of hydrogen, surface preparation, application of different coatings from metals and alloys, anodizing and control of metal coatings and electrolytes.

Literature:

Recommended:

1. Spasoje Đorđević, Miodrag Maksimović, Miomir Pavlović, Konstantin Popov, Galvanotehnika, NIDD „ Tehnička knjiga“, Beograd, 1998. (*in Serbian)*

2. S. Đorđević, Metalne prevlake, Savrmena administracija, Beograd, 1970. (*in Serbian)*

3. A. Despić, Osnove elektrohemije 2000, Zavod za udžbenike i nast. Sredstva, Beograd, 2003. (*in Serbian)*

4. M. Rajčić-Vujasinović, V. Grekulović, Teorija hidro i elektrometalurških procesa, ТФ Бор, 2017. (*in Serbian)*

Ancillary:

1. M. Rajčić-Vujasinović, V. Zlatković, Teorija hidro i elektrometalurških procesa, Praktikum za vežbe, TF Bor, 2001. (*in Serbian)*

2. V. Mišković-Stanković, Metalne i nemetalne prevlake, Praktikum za vežbe, TMF, 2001. (*in Serbian)*

3. M. Rajčić-Vujasinović, Z. Stanković, Praktikum za vežbe iz Fizičke hemije, TF Bor. (*in Serbian)*

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

Teaching methods

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	
Exercise attendance	10	Oral part of the final exam	50
Coloquium exam/s		.....	
Term paper	30		

Study program: Metallurgical Engineering

Course: CONTACT MATERIALS

Lecturer/s: Ivana Markovic, Associated Professor

Status of the course:

Elective subject of the study program Metallurgical Engineering (Module: Processing Metallurgy)

ECTS: 6

Prerequisite: Required knowledge of Physical Metallurgy 1 and 2 and Sintermetallurgy

Course goals: Students should study within the course the obtaining, characterization and application of electrical contacts by sintermetallurgical procedures.

Learning outcomes:

Training students for independent work in the field of testing and characterization of contacts based on various metals and alloys obtained by powder metallurgy technology.

Course description:

Lectures:

Operation of electrical contacts. Materials for electrical contacts. Metal-based materials with a high melting point. Production of materials. Sintered tungsten. Sintered molybdenum. Sintered rhenium. W-Cu composite material. W-Ag composite material. Contact materials for vacuum switching. Dispersion reinforced silver-based materials. Production processes. Metal-graphite composites. Silver-graphite composites. Copper-graphite composites. Precious metal contact materials: gold contact alloys, silver contact alloys, platinum contact alloys, standard shapes and dimensions of precious contact materials. Materials for electrical contacts based on copper alloys at the expense of applying the annealing strengthening effect.

Practice:

Lectures are accompanied by laboratory exercises with the aim of overcoming the techniques for obtaining and characterizing sintered contact materials.

Literature:

Recommended:

1. W. Schatt, K.P.Wieters, Metalurgija praha - prerada i materijali, EPMA,1994.
2. P. Gertik, Plemeniti metali, Svojstva prerada primena, Beograd, 1997.
3. S. Nestorović, Sintermetalurgija - Praktikum, Tehnički fakultet u Boru, 2001.

Ancillary:

1. M. Braunovic, V.V. Konchits, N.K. Myshkin, Electrical Contacts – Fundamentals, Applications and Technology, CRC Press, 2007.
2. P.G. Slade, Electrical Contacts – Principles and Applications, Marcel Dekker, 1999.

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

Teaching methods

Lectures, exercises-practical teaching, preparation of a term paper with a consulting approach to independent work students.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	
Exercise attendance	20	Oral part of the final exam	50
Coloquium exam/s		Practical lectures	
Term paper	30		

Study program: Metallurgical Engineering

Course: SINTERED METALLIC MATERIALS

Lecturer/s: Ivana Markovic, Associated Professor

Status of the course:

Elective subject of the study program Metallurgical Engineering (Module: Processing Metallurgy)

ECTS: 6

Prerequisite: Required knowledge of Sintermetallurgy

Course goals: Upgrading the acquired knowledge from the Sintermetallurgy subject by introducing students to different ways of obtaining and applying sintered metal materials depending on their properties.

Learning outcomes:

Students should overcome theoretical and practical knowledge from the synthesis of sintered metal materials, in order to have the necessary basis to apply them in the field of powder metallurgy in order to characterize and obtain them.

Course description:

Lectures:

Sintered iron-based materials; Sintered materials based on copper and copper alloys; Sintered materials based on light metals; High alloy sintered high density materials; Sliding materials and bearings; Friction materials; Highly porous materials and filters; Materials for electrical contacts; Metal-based materials with a high melting point; Dispersion strengthened silver-based materials; Metal-graphite composites; Sintered high-temperature metals and alloys; Heavy alloys; Sintered magnets; Hard materials.

Practice:

Laboratory exercises accompany the lectures: examination and characterization of green parts and sintered materials according to ISO standards for the field of powder metallurgy.

Literature:

Recommended:

1. W. Schatt, K.P.Wieters, Metalurgija praha - prerada i materijali, EPMA,1994. (prevod-odabrana poglavlja).
2. S. Nestorović, Sintermetalurgija - praktikum, Tehnički fakultet u Boru, 2001.
3. M. Mitkov, D. Božić, Z. Vujović, Metalurgija praha, BMG, Zavod za udžbenike i nastavna sredstva, Vinča,1998.

Ancillary:

1. Z.Z. Fang, Sintering of Advanced Materials Fundamentals and Processes, Woodhead Publishing Limited, 2010.
2. F. Thummler, R.Oberacker, An Introduction to Powder Metallurgy, The Institute of Materials, 1993.

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

Teaching methods

Lectures, exercises-practical teaching, preparation of a term paper with a consulting approach to independent work students.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	
Exercise attendance	20	Oral part of the final exam	50
Coloquium exam/s		Practical lectures	
Term paper	30		

Study program: Mining Engineering, Metallurgical Engineering, Technological Engineering

Course: ECONOMICS AND ORGANIZATION OF BUSINESS

Lecturer: PhD Dejan Riznić, full proffesor

Status of the course: Compulsory for Technological Engineering, Mining Engineering (module EMD), Metallurgical Engineering; elective for Mining Engineering (modules PMD and RTSD).

ECTS: 6

Prerequisite: Knowledge from general technical and technological disciplines and functioning of the business system.

Course goals: The aim of the course is to gain necessary knowledge on the current state of economy and businesses organization, the economy of capital and labor, investments in reproduction, operating expenses, financial result and basic economic principles. Subject is conceived with aim to provide student's acquisition fundamental theoretical and practical knowledge and skill from area of organizations enterprises. Fundamentals of organization will prepare future managers for the challenges of today's business world.

Learning outcomes: Fundamentals of business economics and organization is a microeconomic scientific discipline that ensures gaining the basic knowledge about the operation of enterprises. Getting acquainted with basic economic laws and organization of business.fundamentals of organization will prepare future managers for the challenges of today's business world. Students will discover the most progressive thinking about organizations in real world. Mastering the basic ones economic principles of modern business.

Course description:

Introduction - the subject, objective of studying economics and business organization as an economic discipline.Methods of studying economics and business organization as an economic discipline. Organization of business economy - forms of organization of economic entities. Classification and termination of business entities. Business functions -vertical and horizontal. Economics of funds of business entities - basic and working capital, investments in reproduction, sources of business assets. Liquidity of business entities.Investments. Economics of Labor. Operating costs - price and division, natural costs, cost of reproduction dynamics. Cost dynamics and revenues, cost accounting. Determination and distribution of business results. Basic economic principles. Final Test

Literature:

Recommended:

1. G. Mankiw, Principles of Microeconomics, Harvard University, 2017.
2. P. Milgrom, J. Roberts, Economics, Organization and Management, Published by Prentice Hall, 1992.
3. D.C. Wilson, R.H. Rosenfeld, Managing organizations, Text, readings, and cases. McGraw-Hill, 1990.

Ancillary:

1. R.L. Daft, Organization theory and design, Mason, Ohio: South-Western Cengage Learning, 2010.
2. D. Begg, D. Ward, Economics for Business, Published by McGraw-Hill Higher Education, 2006.
3. E. Mansfield, Managerial Economics 6th, Publisher: W. W. Norton & Company, 2005.

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

Teaching methods

Theoretical teaching with practical applications within the group, individual and combined teaching methods.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	20	Written part of the final exam	15
Exercise attendance		Oral part of the final exam	35
Coloquium exam/s	30		
Term paper			

Study program: Engineering Management, Metallurgical Engineering

Course: Quality Management

Lecturer/s: Predrag Djordjevic, **Associated Professor**

Status of the course: Compulsory for students of Engineering Management Department, elective for students of Metallurgical Engineering Department

ECTS: 6

Prerequisite: Basic knowledge in the fields of mathematics and statistics

Course goals: Acquiring knowledge in the field of quality management and tools for the development of quality systems

Learning outcomes: Practical application of the acquired knowledge for the implementation of the quality system

Course description:

Lectures:

During the course students will acquire knowledge regarding the principles of quality management. Special insight is given to the techniques and tools of quality management, through solving practical problems encountered in everyday industrial practice, while the particular attention is given to the application of statistical tools.

The history of the development of quality management. Concept and definition of quality. Basic characteristics and structure of the ISO 9000 series standard. ISO 14000, ISO 18000, HACCP, ISO 26000. Integrated management systems. Total Quality Management. Quality Controls in Marketing and Procurement. The Principles of the new production philosophy. Circles of Quality Control. Quality Assurance. Quality tools and techniques: Check Sheets, Histograms, Scatter diagram, Pareto analysis, Ishikawa diagram, Process capability, Brainstorming, Affinity Diagrams, Benchmarking process, Houses Of Quality, Statistical methods of Quality Management, Control Charts, Taguchi method. Sampling: concepts, OC curve construction, Reception plans, Sampling process materials. Japanese Quality Control: Kaizen, 5S, 3MU and Kano models.

Practice:

Computational exercises

Literature:

Recommended:

1. Živan Živković, Predrag Đorđević, Upravljanje kvalitetom, Grafomed Bor, Bor, 2022.
2. Đorđević Predrag, Arsić Sanela, Upravljanje kvalitetom - zbirka rešenih zadataka sa izvodima iz teorije, Tehnički fakultet u Boru, Bor, 2017.
3. D. L. Goetsch and S. B. Davis, Quality Management for Organizational Excellence: Introduction to Total Quality, Prentice Hall, 2010.
4. D. Hoyle, Quality Management Essentials, Elsevier, 2007.
5. S. T. Foster, Managing Quality: Integrating the Supply Chain, Prentice Hall, 2012.

Ancillary:

1. F. Gryna, R. C. H. Chua and J. A. De Feo, Juran's Quality Planning and Analysis for Enterprise Quality, McGraw-Hill Education, 2007.
2. C. W. Kang and P. H. Kvam, Basic Statistical Tools for Improving Quality, Wiley, 2011.

Number of classes per week	**Lectures: 3**	**Practical classes: 3**	**Study research work: /**	**Other forms of teaching: /**

Teaching methods

Theoretical lectures and practical applications provided using group, individual and combined teaching methods.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points

Study program: Metallurgical Engineering

Course: DESIGNING IN METAlLURGY

Lecturer/s: Dr. Nada Štrbac, full professor, Dr. Srba Mladenović, full professor, Dr. Ljubiša Balanović, associate professor

Status of the course: Compulsory for study program Metallurgical Engineering

ECTS: 6

Prerequisite:

Required knowledge of black and non-ferrous metallurgy (for the elective module Extractive metallurgy), that is, the foundry and metal processing (for the elective module Processing metallurgy).

Course goals:

Introduction to the students of principles of plant design and equipment selection in metallurgy and the development of teamwork skills in project tasks.

Learning outcomes:

Acquiring basic knowledge in designing plants and equipment selection in metallurgy, as well as initial experience of working in an engineering project team.

Course description:

Lectures:

Design of plants for standard processes and new, specific processes. Basic preconditions for successful design - raw material conditions, energy conditions, transport conditions, personnel base, location conditions, auxiliary raw materials, market. Specificity of design in black metallurgy and design specificities in non-ferrous metallurgy. Specificity of design in processing metallurgy. Plant design for new processes. Phases in the development of a single process, starting idea, theoretical elaboration of the idea, laboratory tests, evaluation of research results, previous technical studies, prototype plant, semi-industrial plant. Design of industrial plant, selection of production cycle based on research results, qualitative process scheme, quantitative process scheme, material balance, energy balance, technical schemes. Selection of equipment for certain metallurgical processes. Spatial arrangement of basic devices.

Practice:

Examples of calculation of devices, technology and technological processes in metallurgy (smelting, refinings, foundry, forgings, rolling mills, thermal processings). Development of projects and parts of projects through seminar papers (elaborates).

Literature:

Recommended:

1. Đ. Zrnić, Projektovanje fabrika, Mašinski fakultet, Beograd, 1993. *(in Serbian)*
2. Đ. Zrnić, M. Prokić, P. Milović, Projektovanje livnica, MF Beograd, 1998. *(in Serbian)*

Ancillary:

1. Đ. Zrnić, D. Petrović, Zbirka rešenih zadataka iz fabričkih postrojenja, MF Beograd, 1992. *(in Serbian)*
2. Z. Popović, K. Raić, Peći i projektovanje u metalurgiji – zbirka rešenih zadataka, Tehnološkometalurški fakultet, Beograd, 1988. *(in Serbian)*
3. Zakonska regulativa u oblasti projektovanja *(in Serbian)*
4. V. A. Avdeev, V. M. Druян, B. I. Kudrin, Osnovы proektirovanия metallurgičeskih zavodov, Intermet inžiniring, Moskva, 2002. *(in Russian)*

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

Teaching methods

Theoretical teaching organized on an interactive basis, with the development of practical examples through group and individual work.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	**5**	Written part of the final exam	
Exercise attendance	**15**	Oral part of the final exam	**60**
Coloquium exam/s		.....	
Term paper	**20**		

Study program: Metallurgical Engineering

Course: PROFESSIONAL PRACTICE

Lecturer/s: Dr. Vesna Grekulović, assistant professor, Dr. Ljubiša Balanović, assistant professor and Dr. Uroš Stamenković, assistant professor

Status of the course: Compulsory

ECTS: 3

Prerequisite: Certified VII semester

Course goals: The aim of the professional practice is that after finishing theoretical lectures, the student is practically acquainted with the application of theory in practice in the production conditions. In the course of professional practice, the student needs to study in more detail the production and processing technology of metals, and to compare it with theoretical knowledge from various subjects examined and laid out.

Learning outcomes: After the practice and the seminar work done, the student will be able to compare the success of applying theoretical knowledge in given practical conditions. In the seminar work, on the concrete case, which the subject teacher entrusts should consider and display positive and negative elements in the technology of production and processing of metals.

Course description:
Teachers in charge of organizing professional practice, in agreement with colleagues from the appropriate company in which practical work is carried out, determine the content and dynamics of the performance of professional practice, and define a concrete case that will be considered in the seminar work.

Number of classes per week	**Lectures:**	**Practical classes:**	**Study research work:**	**Other forms of teaching: 6**

Teaching methods

Professional practice in a company or institution is carried out according to a pre-defined program in accordance with the subject content. Accompanied by an expert from the company where the practice is performed, and a teacher-coordinator of professional practice, the student acquires new practical knowledge using the audio-visual method of learning. At the end of the professional practice, the student submits to the professional practice coordinator a written journal with a description of the activities during the professional practice. After the teacher-coordinator positively evaluates the written journal of professional practice, the student earns the right to take the oral part exam.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	50	Written part of the final exam	
Exercise attendance		Oral part of the final exam	50
Coloquium exam/s		.....	
Term paper			

Study program: Metallurgical Engineering

Course: FINAL WORK – RESEARCH

Lecturer/s: All teachers in the study program are potential mentors

Status of the course: Compulsory

ECTS: 2

Prerequisite: Certified VII semester

Course goals: The goal of the course refers to logical actions that, with the help of abstract concepts, verified theoretical knowledge and empirical research, enable the student to gain new knowledge from the field of research. Training students for independent work after the completion of the academic studies, as well as acquiring the basis for later improvement in master's academic studies.

Learning outcomes: Students master the theoretical and practical phases of scientific research methods. Students learn to use available literature databases (KOBSON, SCOPUS, SCIENCE DIRECT, etc.). With the help of a mentor, students operate on the appropriate equipment and learn to use software for processing experimental data.

Course description:
The course content is based on the basic stages of the methodical procedure of scientific research: (1) formulation of the problem, (2) establishment of the hypothesis, and (3) verification of the hypothesis. The final paper - research is formulated for each student separately, in which the student gets acquainted with the research methodology in the field of metallurgical engineering. The mentor guides the candidate in his work and provides him with assistance in the entire research process, through: choosing the topic of the final paper, formulating the title of the paper, setting the goal of the subject of the work, engineering methods and ways of solving it, approaching the problem, choosing the way to process the problem, experimental work and collection data.

Number of classes per week	**Lectures:**	**Practical classes:**	**Study research work: 2**	**Other forms of teaching:**

Teaching methods

All necessary general scientific research methods with an emphasis on hypothetical-deductive and experimental methods. Sensory-empirical practical activity. The performance methods consist of a theoretical introduction to the problem and independent laboratory work under the supervision of the mentor. During the research, all necessary general scientific research methods are applied in order to obtain valid experimental data.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	50	Written part of the final exam	50
Exercise attendance		Oral part of the final exam	
Coloquium exam/s		.....	

Study program: Metallurgical Engineering

Course: FINAL WORK – PREPARATION AND PRESENTATION

Lecturer/s: All teachers in the study program are potential mentors

Status of the course: Compulsory

ECTS: 2

Prerequisite: Passed all exams provided for the undergraduate academic studies program of the Metallurgical Engineering study program.

Course goals: The aim of the course is related to the processing of experimental data, the analysis of the obtained results and the verification of the proposed hypothesis with the proposed solution of the engineering problem, applying engineering methods, and finally shaping the final work.

Learning outcomes: The student uses software for processing experimental data. With the help of a mentor, he analyzes the obtained results and draws conclusions; creates logical connections between the cause and effect of the observed phenomenon; develops professional competencies and critical thinking in solving real production problems.

Course description:
After completing the experimental research and obtaining valid results, the student prepares a final paper in the form containing the following chapters: introduction (defining the goal of the research and expected results); theoretical part (presentation of the most important theoretical foundations, which represent the basis for certain researches); experimental, practical part (concrete treatment of a given engineering problem), results and discussion (presentation of obtained results in appropriate technical form, with necessary comments and conclusions given in order to solve the current problem), and literature review.
The final paper - preparation and defense is formulated for each student separately, in which the student, with the help of a mentor, performs data processing and analysis of the obtained results using various methodological procedures, verifies the set hypothesis and provides a solution to the set engineering problem. The mentor guides the candidate in his work and provides him with assistance in the entire process of preparing and defending the final thesis. The student submits the final and mentor-approved version of the work, followed by a public defense before the committee. This qualifies the student for independent presentation and defense of acquired engineering knowledge and experience.

Number of classes per week	**Lectures:**	**Practical classes:**	**Study research work:**	**Other forms of teaching: 2**

Teaching methods

Analytical-deductive method and integration of theoretical and empirical aspects of the research subject. Proposal for a solution to the engineering problem. Theoretical interpretation of sensory-practical activity and comparison with already existing results available in the literature.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	50
Exercise attendance		Oral part of the final exam	50
Coloquium exam/s		.....	
Term paper			