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

Undergraduate Academic Studies

(1st level of the Academic Studies)

TECHNOLOGICAL ENGINNERING

BOOK OF COURSES

Bor, 2023

Content

No.	List of courses	
1.	Mathematics 1	4
2.	Physics	5
3.	General chemistry	6
4.	Informatics 1	7
5.	English language 1a	8
6.	Inorganic chemistry	9
7.	Informatics 2	10
8.	Engineering graphics	11
9.	Mathematics 2	12
10.	English language 1b	13
11.	Statistics	14
12.	Physical chemistry	15
13.	Mineralogy	16
14.	English language 2a	17
15.	Analytical chemistry	18
16.	Thermodynamics	19
17.	Fundamentals of Electrical Engineering	20
18.	Organic chemistry	21
19.	English language 2b	22
20.	English language 3a	23
21.	Theoretical foundations of chemical technology	24
22.	Momentum transport	25
23.	Advanced inorganic chemistry	26
24.	*Elective course 1*	
	24.1. Ecology	27
	24.2. Environmental Protection	28
25.	English language 3b	29
26.	General chemical technology	30
27.	Heat and mass transport	31
28.	*Elective course 2*	
	28.1. Electrochemisty	32
	28.2. Toxicology	33
29.	The basis of the instrumental methods	34
30.	Inorganic chemical technology	35
31.	Corrosion and protection	36
32.	Economics and organization of business	37
33.	*Elective course 3*	
	33.1. Design in chemical technology	38
	33.2. Pollution and soil protection	39
34.	*Elective course 4*	
	34.1. Chemical process equipment	40
	34.2. Pollution and air protection	41
35.	*Elective course 5*	
	35.1. Technology of new materials	42
	35.2. Wastewaters	43

Module 1 – Inorganic Chemical Tehnology

36. *Elective course 6*
- *36.1.* Water technology 44
- *36.2.* Materials corrosion 45

37. *Elective course 7*
- *37.1.* Ceramics technology 46
- *37.2.* Glass technology 47
- *37.3.* Fundamentals of vacuum and plasma physics 48

Module 2 – Environmental Engineering

36. *Elective course 6*
- *36.1.* Technology of solid waste treatment and disposal 49
- *36.2.* Purification of waste gases 50

37. *Elective course 7*
- *37.1.* Hazardous organic substances 51
- *37.2.* Metallurgy of secondary raw materials 52
- *37.3.* Physical sources of hazards and environmental protection 53

38. Internship professional practice 54

39. Bachelor thesis – research 55

40. Bachelor thesis – preparation and defense 56

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

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. Ušćumlić, 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

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; PhD Maja M. Nujkić, 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: Mara Ž. Manzalović

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: Technological Engineering, Mining Engineering and Metallurgical Engineering

Course: ANALYTICAL CHEMISTRY

Lecturers: PhD Tanja S. Kalinović, assistant professor; PhD Ana A. Radojević, 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: Technological Engineering

Course: THERMODYNAMICS

Lecturer: PhD Jelena M. Đoković, full professor

Status of the course: Compulsory for Technological Engineering.

ECTS: 8

Prerequisite: Required knowledge of Physics and Physical chemistry.

Course goals: Understanding and learning the fundamental thermodynamic principles and laws, and knowledge of thermodynamic states and state changes of matters included in energy transformations processes. Understanding the principles of operation of thermal engines and refrigeration devices, and knowledge of fundamentals of the energy transfer by heat.

Learning outcomes: Students acquire knowledge that they will apply in further education, as well as in practice, in order to rationalize the use of energy and environmental resources available to us.

Course description:

Lectures:

Thermodynamic system, state properties, state changes. Postulates of thermodynamics. Ideal gas equation of state. Mixtures of ideal gases. Energy of the system, internal energy, modes of energy transfer, heat, work. First law of thermodynamics for closed system, specific heat capacity, enthalpy. Polytropic state changes of ideal gas. First law of thermodynamics for open system. Second law of thermodynamics, entropy, reversible and irreversible thermodynamic processes. Cycles of heat engines: Carnot cycle. Real pure substances – water vapor: phases, diagrams of state, state changes. Humid air. Combustion. Fundamentals of the energy transfer by heat: conduction, convection, radiation, combined transfer. Basic cycles of the internal combustion engines, gas-turbine and vapor-turbine. Basic refrigeration cycles.

Practice:

Numerical examples from all theoretical lectures.

Literature:

Recommended:

1. J. Đoković, Thermodynamics, University of Belgrade, Technical Faculty of Bor, Bor, 2013.
2. B. Đorđević, V. Valent, S. Šerbanović, Thermodynamics with thermal engineering, University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, 2007.
3. Đ. Kozić, Thermodynamics – engineering aspects, University of Belgrade, Faculty of Mechanical Engineering, Belgrade, 2007.

Ancillary:

1. B. Đorđević, V. Valent, S. Šerbanović, Solved problems in thermodynamics with thermal engineering, University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, 2007.
2. B. Vasiljević, M. Banjac, Handbook for thermodynamics – tables and diagrams, University of Belgrade, Faculty of Mechanical Engineering, Belgrade, 2012.

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

Teaching methods

Classic lectures with interactive discussions, practical classes, colloquiums, final exam.

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	30
Colloquium exam/s	20+20+20		
Term paper			

Study program: Technological Engineering and Mining Engineering

Course: FUNDAMENTALS OF ELECTRICAL ENGINEERING

Lecturer: PhD Zoran M. Stević, full professor

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

ECTS: 8

Prerequisites: /

Course goals: Acquiring knowledge on basic electrical engineering laws and their application.

Learning outcomes: Knowledge on electrical machines and devices, their application and protection of man.

Course description:

Lectures:

Electrostatics. Coulomb's law. Potential. Gauss's law. Conductors. Capacitors. Dielectrics. Energy. D.C. fields and circuits. Current field. Joule's law. Electric generators. Kirchhoff's current laws. Circuit solution using Kirchhoff's laws. Mesh analysis. Electric networks with capacitors. Time constant magnetic field. Magnetic flux and induction. Amper's law. Magnetic materials. Magnetic circuit. Time-varying magnetic and electric field. Faraday's law of electromagnetic induction. Inductance. Electric circuits of alternating current. Resonance. Resolving of AC circuits. Three-phase systems. Rotating electric field. Asynchronous and synchronous electric machines. Electricity transmission. Electrical installations and protection.

Practice:

Computational and laboratory exercises, laboratory research experiments and studies.

Literature:

Recommended:

1. Đorđević, Fundamentals of Electrical Engineering, Part 1 to 4, Academic Mind, Belgrade, 2012.

Ancillary:

1. G. Božilović, D. Olćan, A. Đorđević, Collection of problems for Fundamentals of electrical engineering, Part 1 to 4, Academic Mind, Belgrade 2012.

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

Teaching methods

Interactive presentations, computational and laboratory exercises and demonstrations.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	0–30*
Exercise attendance	20	Oral part of the final exam	30
Coloquium exam/s	30		
Term paper	10		

*Total number of points includes points from colloquium exams.

Study program: Technological Engineering and Mining Engineering

Course: ORGANIC CHEMISTRY

Lecturer: PhD Slađana Č. Alagić, full professor

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

ECTS: 6

Prerequisite: Knowledge on the atom structure, chemical bonds, chemical reactions classification, stoichiometry.

Course goals: Understanding of the structure of organic molecules, classes of organic compounds (and their reactions), nomenclature of organic compounds and the correlation of the organic compound structure with its physical-chemical characteristics. Education on basic experimental techniques in organic chemistry laboratory, characterization of organic compounds and experimental synthesis of simple organic compounds.

Learning outcomes: Better understanding of many technological subjects due to the wide utilization of numerous organic compounds in technological procedures. Also, a better understanding of the ecological and toxicological problems because numerous organic compounds are serious hazardous pollutants.

Course description:

Lectures:

Diversity and the amount of organic compounds. Covalent bonding, hybridization, intermolecular interactions, electron effects, types of reactions in organic chemistry. Methods for solid substances obtaining, their identification, and evaluation. Structural theory. Isomers. Classes of organic compounds: 1) Hydrocarbons: alkanes, alkenes, alkynes, aromatic compounds; 2) Organohalide compounds; 3) Organooxigen compounds: alcohols, ethers, phenols, aldehydes and ketones, carboxylic acids and their derivates; 4) Organonitrogen and organosulfur compounds – aliphatic and aromatic (5 or 6 membered heterocyclic compounds); 5) Organic compounds – bio-molecules: lipids, carbohydrates, proteins.

Practice:

Experiments in the laboratory – determination of some physic characteristics, characterization and basic elemental analysis of organic compounds with calculations; identification of functional groups; preparative organic chemistry – synthesis of simple organic compounds. Methods of solvent extraction of organic compounds from natural products; chromatography methods.

Literature:

Recommended:

1. R. Palić, N. Simić, Organska hemija, I izdanje, Univerzitet u Nišu, PMF, Niš, 2007.
2. G.A. Taylor, Organska hemija, III izdanje, Naučna knjiga, Beograd, 1995.
3. Presentation of the lecturer.
4. V. Savić, M. Simić, M. Petković, G. Tasić, P. Jovanović, Z. Tokić Vujošević, S. Dilber, Praktični kurs iz organske hemije, Farmaceutski fakultet, Beograd, 2017.
5. J. Rikovski, Organska hemija, Građevinska knjiga, Beograd, 1979.

Ancillary:

1. S. Arsenijević, Organska hemija, Naučna knjiga, Beograd 1990.
2. K.P.C. Vollhardt, N.E. Schore, Organic chemistry, Structure and Function, 6th Ed., 1999, 2003, 2011, W.H. Freeman and Company, USA.
3. B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, Vogel's Textbook of Practical Organic Chemistry, 5th Ed., Longman Group UK Limited, 1989.
4. S.D. Petrović, D.Ž. Mijin, N.D. Stojanović, Hemija prirodnih organskih jedinjenja, Tehnološko–metalurški fakultet, Beograd, 2009.

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

Teaching methods

Teaching with interactive discussions, experimental work and calculations, consultations, colloquiums.

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	20+20		
Term paper			

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

Course: ENGLISH LANGUAGE 2b

Lecturer: Mara Ž. Manzalović

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: Technological Engineering

Course: THEORETICAL FOUNDATIONS OF CHEMICAL TECHNOLOGY

Lecturers: PhD Tanja S. Kalinović, assistant professor; PhD Marija B. Petrović Mihajlović, associate professor

Status of the course: Compulsory for Technological Engineering.

ECTS: 6

Prerequisite: Acquired knowledge of Physical chemistry.

Course goals: Getting to know of students with theoretical foundations in the field of chemical thermodynamics and kinetics of technological processes.

Learning outcomes: Students master the most important laws and terms of thermodynamics and kinetics of the systems that occur in inorganic chemical technology. Students adopt the theoretical basics for understanding the lectures from the specialized courses in the fourth year of the study program. Application of the acquired knowledge will enable successful monitoring and analysis of thermodynamic and kinetic parameters of technological processes with the aim of increasing efficiency and yield.

Course description:

Lectures:

Basic laws of chemical thermodynamics. Thermal effect of chemical reactions and phase transformations. Chemical potential. Relations between the basic thermodynamic properties of the state of a system. Thermochemistry of chemical reactions. Thermodynamics of ideal and real gases. The laws of chemical reactions equilibrium. Partial molar properties. Equilibrium of phases and phase transformations. Thermodynamics of phase transitions. Thermodynamic properties of ideal and non-ideal solutions. Basic laws of chemical kinetics. Temperature dependence of reaction rates. Kinetic laws of complex chemical reactions. Mechanisms of chemical reactions. Kinetics of homogeneous and heterogeneous catalytic reactions. Kinetics of heterogeneous-topochemical reactions. Examples of topochemical reactions.

Practice:

Calculation exercises.

Literature:

Recommended:

1. R. Ninković, M. Todorović, J. Miladinović, D. Radovanović, Teorijski osnovi neorganske hemijske tehnologije – I deo, Tehnološko-metalurški fakultet, Beograd, 2003.
2. M. Rajčić Vujasinović, Teorijske osnove hemijske tehnologije, Autorizovana predavanja, Tehnički fakultet u Boru, Bor.
3. D. Živković, Ž. Živković, Zbirka zadataka iz teorije metalurških procesa 2 deo, Tehnički fakultet u Boru, Bor, 2001.

Ancillary:

1. Z. Zavargo, R. Paunović, Osnovi hemijske termodinamike, Tehnološki fakultet, Novi Sad, 1997.
2. D. Šepa, Osnovi hemijske kinetike, Akademska misao, Beograd, 2001.
3. Ž. Živković, D. Živković, Zbirka zadataka iz teorije metalurških procesa 1 deo, Tehnički fakultet u Boru, Bor, 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 demonstration 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	10+10		
Term paper			

Study program: Technological Engineering

Course: MOMENTUM TRANSPORT

Lecturers: PhD Snežana M. Milić, full professor; PhD Ana T. Simonović, assistant professor

Status of the course: Compulsory for Technological Engineering.

ECTS: 8

Prerequisite: Basic knowledge of Thermodynamics and Physical chemistry.

Course goals: Mastering the basic laws of fluid movement transfer operations and heterogeneous systems in technological processes.

Learning outcomes: Using the basic operations of transferring the amount of movement of fluids and heterogeneous systems and their application in the processing of technological processes.

Course description:

Lectures:

Movement transport operations. Properties of fluids. Bernoulli's equation. Fluid flow regime. Similarity theory and dimensional analysis. Boundary layer. Fluid transport. Fluid transport devices. Basics of hydrodynamics of heterogeneous systems. Movement of particles through a fluid. Classification and centrifugation. Fluid movement through a porous medium. Filtering, fluidization and mixing operations. Movement of bubbles through liquid.

Practice:

Computational and laboratory processing of examples from the field of theoretical teaching.

Literature:

Recomended:

1. Ž. Grbavčić, T. Kaluđerović-Radoičić, Mehaničke operacije, Tehnološko-metalurški fakultet, Beograd, 2016.
2. V. Stanković; Fenomeni prenosa i operacije u metalurgiji, I tom, Tehnički fakultet u Boru, Bor, 1998.
3. A. Tasić, R. Radosavljević, R. Cvijović, F. Zdanski, Tehnološke operacije – Mehaničke – zbirka zadataka, Tehnološko-metalurški fakultet, Beograd, 1991.
4. D. Vulićević, Tehnološke operacije – Dijagrami, nomogrami, tabele, TMF, Beograd, 2008.
5. S. Šerbula, V. Stanković, Praktikum za tehnološke operacije, Tehnički fakultet u Boru, Bor, 2010.

Ancillary:

1. F. Zdanski, Mehanika fluida – teorija operacija prenosa količine kretanja, Tehnološko-metalurški fakultet, Beograd, 1995.
2. D. Simonović, D. Vuković, S. Cvijović, S. Končar-Đurđević; Tehnološke operacije 1 – Mehaničke operacije, Tehnološko-metalurški fakultet, Beograd, 1980.

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

Teaching methods

Classical lectures with interactive discussions, computational and laboratory exercises, consultations and colloquiums.

Knowledge evaluation (maximum number of points 100)

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	40
Colloquium exam/s	20		
Term paper			

Study program: Technological Engineering

Course: ADVANCED INORGANIC CHEMISTRY

Lecturer: PhD Milan B. Radovanović, associate professor

Status of the course: Compulsory for Technological Engineering.

ECTS: 6

Prerequisite: Required knowledge of Inorganic chemistry.

Course goals: Acquiring knowledge for a better understanding of molecular structure and complex compounds.

Learning outcomes: Better understanding of the decomposition and synthesis of compounds in technological processes.

Course description:

Lectures:

Atomic orbitals. Wave function. The wave equation. Hydrogen atomic orbitals. Multi-electron atoms. Covalent bond. The valence bond method. The method of molecular orbitals. Polyatomic molecules. Polycentric connections. Molecular spectra. Interatomic distances. Stereochemistry. Ionic bond. Ionic molecules. Ionic structures. Hydrogen bond. Complex compounds. Theory of coordination. Magnetic properties of the complex. Ligand field theory. Nuclear magnetic resonance. Metal connection. Crystal structure of metals and alloys. Electronic theory of metals.

Practice:

Calculation and laboratory exercises.

Literature:

Recommended:

1. I. Filipović, S. Lipanović, Opća i anorganska kemija, I deo, Školska knjiga, Zagreb, 1995.
2. I.O. Juranić, Hemijska veza, Hemijski fakultet, Beograd, 1997.
3. Lecture materials.

Ancillary:

1. D. Grdenić, Molekule i kristali, Školska knjiga, Zagreb, 2005.
2. M. Radovanović, Praktikum iz neorganske hemije 2, Tehnički fakultet u Boru, Bor 2021.

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

Teaching methods

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

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
Colloquium exam/s	30		
Term paper			

Study program: Technological Engineering

Course: ECOLOGY

Lecturer: PhD Slađana Č. Alagić, full professor

Status of the course: Elective for Technological Engineering (compulsory for module EE).

ECTS: 8

Prerequisite: Fundamental knowledge on basic classes of organic compounds, structure and function of biomolecules.

Course goals: Clarification of basic ecological terminology – ecology is principally biological science, not the science of environmental protection. Concretization of basic ecological principles. Acquiring knowledge about basic processes and phenomena in the environment emphasizing sensitive equilibrium in ecosystems and developing awareness of the need for preserving and protecting of the environment.

Learning outcomes: Starting from the basic principles of ecology, enable detection and definition of the most important problems in the area of environmental protection and improvement, as well as their ranking in relation to human health and the quality of life in general.

Course description:

Lectures:

The importance and goal of ecology studying. Branches of ecology. Basic terms in ecology: biotope, biocenosis, ecosystem, etc. The structure of the ecosystem and its variability. Ecological factors and their division. Levels of the organization of living beings. Organism as a component of a hierarchy system. Adaptation. Life forms. The main types of ecosystems on Earth. Natural cycles of matter in the environment and the flow of energy. Biosphere as the unique ecological system of the Earth. The influence of man on the biosphere – beneficial and negative. Introduction to basic concepts of pollution and protection of water, air and soil as well as food pollution, radioactivity, noise. Monitoring system for environmental pollution. Significance of statistical research in ecology. Ecological ethics.

Practice:

Introduction to the systematics of plant and animal species (parallels with biodiversity in the surrounding environment). Indication of the differences between plant and animal cells, tissues and organs. Creation of herbarium, microbiological preparates, and insectarium. Detecting life forms of plants and animals in the polluted urban and industrial environment and comparison with forms from the unpolluted environment. Indication of the existence of any specific bioindicators. Extraction of water samples, soil and biological material for the purpose of their analysis in the laboratory. Experimental filtration, sedimentation, neutralization and precipitation of pollutants from water and air samples. Experimental determination of present pollutants, especially heavy metals in all environmental matrices, as well as in biological material. Research and prediction of conditions in surrounding ecosystems, formulation of plan of statistical research. Visits to National parks.

Literature:

Recommended:

1. Power-Point presentation of the lecturer.
2. D. Lakušić, J. Šinžar-Sekulić, T. Rakić, M. Sabovljević, Osnovi ekologije, Biološki fakultet, Beograd 2015.
3. A. Bibi i E.-M. Brenan, Osnovi ekologije, KLIO, Beograd, 2008.
4. M. Vuković, Osnovi ekologije, Tehnički fakultet, Bor, 2004.

Ancillary:

a. S.E. Manahan, Environmental Chemistry, 7th edition, Lewis Publishers, 2000.
b. E.P. Odum, Fundamentals of Ecology, Third Edition. W.B. Saunders company. Philadelphia, London, Toronto, 1974.

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

Teaching methods

Teaching with interactive discussions, experimental work and calculations, consultations, colloquium.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	70
Exercise attendance	10	Oral part of the final exam	
Colloquium exam/s	10		
Term paper			

Study programs: Technological Engineering and Mining Engineering

Course: ENVIRONMENTAL PROTECTION

Lecturer: PhD Maja M. Nujkić, associate professor

Status of the course: Elective for Technological Engineering (compulsory for module ICT) and Mining Engineering (modules PMD and RTSD).

ECTS: 8

Prerequisite: Acquired knowledge in the field of chemistry.

Course goals: Acquiring basic knowledge about the sources of environmental pollution, which include, to a large extent, different anthropogenic influences. Considerating all possibilities that can prevent soil, water and air degradation, which are leading to a new and clean technologies.

Learning outcomes: Students need to acquire knowledge about new measures, primarily from the domain of technology, which can restore damaged ecosystems, or improve the state of basic abiotic ecological factors.

Course description:

Lectures:

Principles of the environment and ecology. The significance of chemistry in environmental protection. Anthropogenic factor – the driving force in the environment. Structure and chemistry of the biosphere. Interaction of organisms in ecosystems. Food chains. Geochemical and biogeochemical cycles. Ecological importance and composition of air. Sources and classification of air pollutants. Protection of air and climate. Drinking and wastewaters. Water quality and improvement of water purification technologies. Water protection. The importance and composition of the soil. Pollution sources and categories of soil contamination. Remediation technology for contaminated soil. Influence of accident and natural disasters on environmental factors. Cycling of polluted substances in nature and their degradation.

Practice:

Calculation examples and experiments related to monitoring and determination of the air, water, and soil pollution, and their purification. Use of library material and electronic databases in order to create a Independent work.

Literature:

Recommended:

1. L. Kolomejceva-Jovanović, Chemistry and Environmental Protection, Union of Engineers and Technicians of Serbia, Belgrade, 2010.
2. M. Nujkić, Ž. Tasić, Practicum of air, water and soil testing, University of Belgrade, Technical faculty in Bor, Bor, 2021.
3. M. Vuković, Basics of ecology, Grafomed-trade, Bor, 2005.

Ancillary:

1. P. Pfendt, Environmental chemistry, I part, Zavod za udžbenike, Belgrade, 2009.
2. M. Jakovljević, M. Pantović, Soil and water chemistry, Scientific book, 1991.
3. J. Švarc-Gajić, Sampling and preparation of samples for analysis, Faculty of Technology Novi Sad, 2012.
4. M. Stanojević, Treatment of drinking water, Construction book, Belgrade, 2009.

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

Teaching methods

Lecturing with interactive discussions, laboratory exercises, consultations and working on term paper.

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	60
Colloquium exam/s			
Term paper	30		

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: Technological Engineering

Course: GENERAL CHEMICAL TECHNOLOGY

Lecturer: PhD Žaklina Z. Tasić, associate professor

Status of the course: Compulsory for Technological Engineering.

ECTS: 8

Prerequisite: Necessary knowledge of Physical chemistry.

Course goals: Students will acquire basic knowledge about technological processes, chemical reactors, fuels, ceramic materials technology and copper production.

Learning outcomes: Students are introduced to the general principles of technological processes and specific technologies of general importance, which will facilitate their understanding of other technologies.

Course description:

Lectures:

Basic technological indicators of chemical production. Raw materials and energy in the chemical industry. Material and energy balances. Formation of technological processes. Process analysis. Stoichiometric calculations. Chemical reactors. Calculation of ideal reactors. Renewable and nonrenewable energy sources. Solid, liquid and gaseous fuels. Kinetics and fuel combustion mechanism. Nuclear fuels and nuclear reactors. Non-organic mortar binders, ceramics based on clay as raw materials. Modern ceramic materials. Reactions at elevated temperatures. Preparation of raw materials. Design, drying, baking and sintering. Refractory and building materials. Glass and glass production. Extractive copper metallurgy.

Practice:

Calculation and laboratory exercises.

Literature:

Recommended:

1. Lj. Kostić-Gvozdenović, R. Ninković, Inorganic chemical technology, TMF, Belgrade, 1997.
2. I. Žižović, Fundamentals of Reactor Engineering, TMF, Belgrade, 2010.
3. D. Gvozdenac, B. Nakomčić-Smaragdakis, B. Gvozdenac-Urošević, Renewable energy sources, Faculty of Technical Sciences, Novi Sad, 2011.
4. T. Volkov-Husović, K. Raić, Goriva i sagorevanje, Savez inženjera metalurgije Srbije, Beograd, 2008.
5. S. Grujić, Kristalizacija stakla, nukleacija i rast kristala, TMF, Beograd, 2013.
6. M. Tecilazić-Stevanović, Osnovi tehnologije keramike, TMF, Beograd, 1990.
7. T. Volkov-Husović, Vatrostalni materijali - svojstva i primena (ispitivanje vatrostalnih materijala), TMF, Beograd, 2004.

Ancillary:

1. M. Maksimović, Hemijski reaktori – Teorija i primeri, Tehnološki fakultet, Banja Luka, 2015.
2. LJ. Kostić-Gvozdenović, M. Todorović, R. Petrović, Praktikum iz tehnologije keramike, TMF, Beograd, 2000.
3. M. Jovanović, LJ. Kostić-Gvozdenović, N. Blagojević, Praktikum iz tehnologije stakla, TMF, Beograd, 1997.

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

Teaching methods

Teaching with interactive discussions, experimental work and calculations, consultations and colloquium.

Knowledge evaluation (max. number of points 100)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	30
Exercise attendance	10	Oral part of the final exam	40
Colloquium exam/s	15		
Term paper			

Study program: Technological Engineering

Course: HEAT AND MASS TRANSPORT

Lecturers: PhD Snežana M. Šerbula, full professor; PhD Ana T. Simonović, assistant professor

Status of the course: Compulsory for Technological Engineering.

ECTS: 8

Prerequisite: Basic knowledge of Physics, Thermodynamics and Physical chemistry.

Course goals: Mastering the basic laws of heat and mass transfer operations in technological processes.

Learning outcomes: Use of basic heat and mass transfer operations and their application in more efficient technological processes.

Course description:

Lectures:

Basic equations and methods of determining stationary and non-stationary heat transport by conduction and convection. Application of similarity theory and dimensional analysis to heat transoprt. Heat transoprt during phase change. Heat transport by radiation. Sources and carriers of heat. Heat exchange, cooling, condensation and evaporation.

Fundamentals of mass transoprt. Molecular and turbulent diffusion. Basic equations of stationary and non-stationary mass transoprt. Application of similarity theory and dimensional analysis to mass transoprt. Analogies of transmission. Interfacial mass transport and mass transport theory. Gradual and differential mass transport. Calculation of static and kinetic parameters of mass transport operations. Simultaneous transport of heat and mass. Mass transport and chemical reactions. Mass transport operations. Distillation, rectification, absorption, adsorption, extraction, drying.

Practice:

Computational and laboratory processing of examples from the field of theoretical teaching.

Literature:

Recomended:

1. B. Đorđević, S. Šerbanović, A. Tasić, E. Živković, M. Kijevčanin, V. Valent, Toplotne operacije, TMF, Beograd, 2018.
2. A. Duduković, Osnovi operacije prenosa mase, TMF, Beograd, 2018.
3. V. Stanković, Fenomeni prenosa i operacije u metalurgiji, II tom, Tehnički fakultet, Bor, 1998.

Ancillary:

1. S. Cvijović, Tolotne operacije, Zadaci sa izvodima iz teorije, Akademska misao, Beograd, 2007.
2. S. Cvijović, N. Bošković-Vragolović, R. Pjanović, Difuzione operacije, Zadaci sa izvodima iz teorije, Akademska misao, Beograd, 2007.
3. S. Šerbula, V. Stanković, Praktikum za tehnološke operacije, Tehnički fakultet u Boru, Bor, 2010.
4. D. Vulićević, Tehnološke operacije – Dijagrami, nomogrami, tabele, TMF, Beograd, 2008.

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

Teaching methods

Classical lectures with interactive discussions, computational and laboratory exercises, consultations and colloquiums.

Knowledge evaluation (maximum 100 points)

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

Study program: Metallurgical Engineering and Technological Engineering

Course: ELECTROCHEMISTRY

Lecturer: PhD Vesna Grekulović, full 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.

Ancillary:

1. M. Rajčić-Vujasinović, V. Zlatković, Teorija hidro i elektrometalurških procesa, Praktikum za vežbe, TF Bor, 2001.
2. Z. Stanković, M. Rajčić-Vujasinović, Praktikum za vežbe iz Fizičke hemije, TF Bor.
3. S. Đorđević i drugi, Galvanotehnika, Tehnička knjiga, Beograd, 1998.
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: Technological Engineering

Course: TOXICOLOGY

Lecturer: PhD Slađana Č. Alagić, full professor

Status of the course: Elective for Technological Engineering (compulsory for module EE).

ECTS: 4

Prerequisite: Fundamental knowledge on inorganic and organic elements and compounds, especially on structure and function of biomolecules.

Course goals: Introduction of students into the field of basic classes of inorganic and organic hazardous substances of natural or anthropogenic origin, connection with principles of their acting (direct chemical irritation of tissues, enzyme inhibition, metabolism disturbance, inhibition of oxygen transport, inhibition of cell transpiration, oxidative stress, necrosis and apoptosis), and biochemical transformations in organisms.

Learning outcomes: Understanding of xenobiotic and natural toxic substances (inorganic and organic), which represent serious threat in the environment (including the occupational environment). Understanding of biochemical acting mechanisms in organisms, transformations in the environment and risk assessment.

Course description:

Lectures:

Subject, outcome, and multidisciplinary basis of toxicology. Understanding of basic fundamentals in toxicology: definition and classifications of toxic substances, exposition to toxic substances, toxic substances in metabolism, toxic-kinetic/dynamics, toxic effects on organs and organ systems. Toxic effects of elements and compounds (inorganic and organic): heavy metals, toxic gases, medicines, addiction causing agents, genotoxic compounds, organic solvents, persistent organic pollutants. Toxic effects of natural compounds. Ecotoxicology: transfer of toxic substances through environmental matrices, air, water, and soil pollution, food contamination, transfer of toxic substances into organisms, bioconcentration, biodegradation and biomarkers.

Practice:

Toxicity tests and risk assessment, statistical analyses and results interpretation. Experimental analysis and detection of inorganic and organic toxic substances in the environment and living organisms. Experimental investigations of influence of toxic substances on plant development. Introducing with the lists of hazardous chemicals that describe their chemical, physical, and toxicological characteristics (Safety Data Sheets), as well as with basic information on the protection measures regarding the treatment, preservation, and transporting of hazardous chemicals.

Literature:

Recommended:

1. S.Č. Alagić, Toksikologija, Tehnički fakultet u Boru, Univerziteta u Beogradu, Bor, 2012.
2. V. Matović, M. Đukić, B. Antonijević, D. Vujanović, Z. Bulat, Praktikum iz toksikologije sa analitikom, Farmaceutski fakultet, Beograd 2017.
3. Ž. Tasić, M. Nujkić, Praktikum iz Toksikologije, Univerzitet u Beogradu, Tehnički fakultet u Boru, Bor, 2021.

Ancillary:

1. M.P. Milošević, S.LJ. Vitorović, Osnovi toksikologije sa elementima ekotoksikologije, Naučna knjiga, Beograd, 1992.
2. S.E. Manahan, Toxicological Chemistry and Biochemistry, 3rd Ed., Lewis Publishers, CRC Press Company, Boca Raton, London, New York, Washington, D.C., 2003.
3. E. Hodgson, A Textbook of Modern Toxicology, 3rd Ed., John Wiley & Sons, Inc., 2004.
4. F. Plavšić, I. Žuntar, Uvod u analitičku toksikologiju, Školska knjiga, Zagreb, 2006
5. D. Đurić, LJ. Petrović, Zagađenje životne sredine i zdravlje čoveka – Ekotoksikologija, 1996.

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

Teaching methods

Teaching with interactive discussions, experimental work and calculations, consultations, and colloquium.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	10	Written part of the final exam	70
Exercise attendance	10	Oral part of the final exam	
Colloquium exam/s	10		
Term paper			

Study program: Technological Engineering

Course: THE BASIS OF THE INSTRUMENTAL METHODS

Lecturers: PhD Milan B. Radovanović, associate professor; PhD Maja M. Nujkić, associate professor

Status of the course: Compulsory for Technological Engineering.

ECTS: 8

Prerequisite: Required knowledge of Analytical chemistry and Physical chemistry.

Course goals: Acquiring knowledge about the theoretical foundations and principles on which the application of non-spectroscopic, spectroscopic, thermal and electroanalytical methods is based.

Learning outcomes: Assumption the knowledge of construction models and operating parameters of instruments used for analysis in various fields of chemical technology, including environmental protection. In addition, the task is to get a picture of the areas of application for each method separately, and to see the areas of application where combining several methods is the best solution.

Course description:

Lectures:

Optical properties of matter. Refractometry. Polarimetry. Interferometry. Nephelometry and turbidimetry. Atomic and molecular spectra. Spectrochemical analysis. Absorption and emission methods. Colorimetry. UV-VIS spectrophotometry. Atomic absorption spectrophotometry. IR spectrophotometry. Flame photometry. Fluorimetry. X-ray fluorescence and diffraction analysis. Mass spectrometry. Nuclear magnetic resonance. Thermal methods. Electroanalytical methods.

Practice:

Laboratory exercises.

Literature:

Recommended:

1. J. Mišović, T. Ast, Instrumentalne metode hemijske analize, TMF, Beograd, 1989
2. D.A. Skoog, D.M. West, F.J. Holler, Osnove analitičke hemije, Školska knjiga, Zagreb, 1999.
3. M. Todorović, P. Đurđević, V. Antonijević, Optičke metode instrumentalne analize, Hemijski fakultet, Beograd, 1997.
4. S. Milosavljević, Strukturne instrumentalne metode, Hemijski fakultet, Beograd, 2004.
5. Lj. Fotić, M. Laušević, D. Skala, M. Bastić, Instrumentalne metode hemijske analize – praktikum za vežbe, TMF, Beograd, 1990.
6. B. Vučurović, L. Sajc, S. Stanković, Elektroanalitičke metode – praktikum za laboratorijske i računske vežbe, TMF, Beograd, 2001.

Ancillary:

1. N. Marjanović, Instrumentalne metode analize – metode razdvajanja, Tehnološki fakultet, Banja Luka, 2001.
2. V. Kuntić, Odabrane instrumentalne metode u medicinskoj biohemiji, Farmaceutski fakultet, Beograd, 2018.

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

Teaching methods

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

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	
Exercise attendance	20	Oral part of the final exam	50
Colloquium exam/s	25		
Term paper			

Study programme: Technological Engineering

Course title: INORGANIC CHEMICAL TECHNOLOGY

Lecturer: PhD Milan B. Radovanović, associate professor

Status of the course: Compulsory for Technological Engineering.

ECTS: 8

Prerequisite: Required knowledge of General chemical technology.

Course goals: Introducing students to the main inorganic chemical technologies.

Learning outcomes: Students will possess concrete knowledge that they can directly use in industrial plants where these technologies are represented.

Course description:

Lectures:

Water technology. Technologies for obtaining gases. Oxygen, hydrogen, carbon dioxide, carbon monoxide, nitrogen oxides. Technologies for obtaining ammonia, nitric acid and nitrates. Catalysts in the synthesis of ammonia and nitric acid. Technologies for obtaining sulfuric acid - contact procedure, catalysts, construction materials. Hydrohalic acids. Phosphoric acid. Base acquisition technologies. Inorganic salts and fertilizers. Technologies for obtaining iron and steel.

Practice:

Computational and laboratory exercises.

Literature:

Recommended:

1. Lj. Kostić-Gvozdenović, R. Ninković, Neorganska hemijska tehnologija, TMF, Beograd, 1997.
2. R. Ninković, L. Knežić, Lj. Kostić-Gvozdenović, N. Blagojević, B. Božović, V. Pavićević, Neorganska hemijska tehnologija – praktikum, TMF, Beograd, 2001.
3. V. Trujić, N. Mitevska, Metalurgija gvožđa, Institut za bakar Bor, Bor, 2007.
4. M. Gojić, Metalurgija čelika, Metalurški fakultet, Sisak, 2005.

Ancillary:

1. D. Vitorović, Hemijska tehnologija, Naučna knjiga, Beograd, 1990.
2. D. Đokić, L. Knežić, Praktikum iz neorganske hemijske tehnologije – veštačka đubriva, TMF, Beograd, 1972.
3. M. Stanojević, Tretman pijaće vode, Građevinska knjiga, Beograd, 2009.
4. M. Radovanović, M. Antonijević, Ekološki prihvatljivi inhibitori korozije bakra i čelika, Grafomed, Bor, 2022.

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 colloquium.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	
Exercise attendance	10	Oral part of the final exam	50
Colloquium exam/s	15+20		
Term paper			

Study program: Technological Engineering

Course: CORROSION AND PROTECTION

Lecturer: PhD Žaklina Z. Tasić, associate professor

Status of the course: Compulsory for Technological Engineering.

ECTS: 6

Prerequisite: Required knowledge of Physical chemistry.

Course goals: Introducing students to various forms of material corrosion and mechanisms of corrosion processes, as well as basic methods of corrosion protection.

Learning outcomes: Theoretical and experimental knowledge will enable students to better understand the role of corrosion in technological processes and to apply various methods of corrosion protection.

Course description:

Lectures:

Corrosion of structural materials and its consequences. Electrochemical corrosion of metals and alloys. Thermodynamics. E-pH diagrams. Causes of electrochemical corrosion. Basic characteristics of electrochemical corrosion. Kinetics of electrochemical corrosion of metals. Passivity of metals. Types of electrochemical corrosion. Atmospheric and chemical corrosion. Corrosion of non-metals. Corrosion of organic materials. Protection against corrosion. Electrochemical protection. Cathodic and anodic protection. Protectors. Protection of metals by treating the corrosive environment. Corrosion inhibitors. Protection of metals by coatings, plating, and rational design.

Practice:

Laboratory practicals.

Literature:

Recommended:

1. S. Mladenović, Korozija i zaštita materijala, TMF, Beograd, 1995.
2. I. Granić, Galvanizacija – zaštita metala od korozije, Tehnička nova knjiga, Beograd, 2013.
3. M.G. Pavlović, D. Stanojević, S. Mladenović, Korozija i zaštita materijala, Tehnološki fakultet, Zvornik, 2012.
4. Z. Gulišija, Č. Lačnjevac, Korozija i zaštita materijala, ITNMS, IDK, Beograd, 2012.
5. V. Vujučić, Korozija i tehnologija zaštite metala, VIZ, Vojna akademija, Beograd, 2002.

Ancillary:

1. V. Mišković-Stanković, Metalne i nemetalne prevlake, Praktikum za vežbe, TMF, Beograd, 2001.
2. S. Mladenović, M. Petrović, G. Rikovski, Korozija i zaštita materijala, Rad, Beograd, 1985.
3. M.B. Petrović Mihajlović, M.M. Antonijević, Inhibitori korozije bakra, Tehnički fakultet u Boru, Bor, 2017.
4. M. Radovanović, M. Antonijević, Ekološki prihvatljivi inhibitori korozije bakra i čelika, Grafomed, Bor, 2022.

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

Teaching methods

Classic lectures with interactive discussions, experimental work, colloquiums, final exam.

Knowledge evaluation (max. number of points 100)

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	40
Colloquium exam/s	20+20		
Term paper			

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: Technological Engineering

Course: DESIGN IN CHEMICAL TECHNOLOGY

Lecturer: PhD Maja M. Nujkić, associate professor

Status of the course: Elective for Technological Engineering (compulsory for module ICT).

ECTS: 8

Prerequisite: Acquired knowledge in the field of Mechanical operations and Heat and mass transfer operation.

Course goals: Introduction students with basic principles of design in chemical technology.

Learning outcomes: Gaining the skills and knowledge necessary for on your own collecting relevant information about process, as well as finding the best solution for a particular project task. Students are trained to select the best available technology and based on that the device and equipment needed for the selected technological process.

Course description:

Lectures:

Basics of design in chemical industry. Phases in the development on the technological process - the idea, theoretical consideration of the initial idea, laboratory tests and analysis of the research results, the previous technical studies, prototype plant and semi industrial plant. Choice of technological process based on the results. Principal and technological scheme of the process. Material, heat and energy balance. Technical schemes. Spatial arrangement of basic and auxiliary devices. Economic analysis. Environmental impact assessment.

Practice:

Practical application of theoretical knowledge in the chosen case. Create individual or group project.

Literature:

Recommended:

1. R. Šećerov-Sokolović, Projektovanje tehnoloških procesa, Tehnološki fakultet, Novi Sad, 2000.
2. R.V. Mitrović, Projektovanje tehnoloških procesa, Naučna knjiga, Beograd, 1991.
3. M.B. Jovanović, Osnovi tehnološkog projektovanja, Savez hemičara i tehnologa Srbije, Beograd, 2004.

Ancillary:

1. B.M. Bugarski, Projektovanje procesa i uređaja u biotehnologiji i biohemijskom inženjerstvu, Akademska misao, Beograd, 2005.
2. M. Bogner, P. Zekonja, D. Ivanović, Priručnik za izradu projektne dokumentacije, ETA, Beograd, 2007.
3. E.E. Ludwig, Applied Process Design for Chemical and Petrochemical Plants, Elsevier Gulf, USA, 2001.
4. N.P. Cheremisinoff, Handbook of Chemical Processing Equipment, Elsevier Butterworth-Heinemann, USA, 2000.

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

Teaching methods

Classical lectures with interactive discussions, computational exercises, consultations and mid-term exam.

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	50
Colloquium exam/s			
Project development	40		

Study program: Technological Engineering

Course: POLLUTION AND SOIL PROTECTION

Lecturer: PhD Ana T. Simonović, assistant professor

Status of the course: Elective for Technological Engineering (compulsory for module EE).

ECTS: 8

Prerequisite: Acquired knowledge in Ecology.

Course goals: Acquaintance of students with soil chemistry, contamination and methods of purifying contaminated soil.

Learning outcomes: Students are trained to diagnose soil pollutants and can propose protection measures based on that.

Course description:

Lectures:

Soil chemistry and composition. Mineral and organic part. Soil colloids. Soil buffering capacity. Soil acidity and alkalinity. The liquid phase of the soil. Gas phase of soil. Soil pollution and sources of pollution. Signs of pollution. Nitrogen and phosphorus pollution. Sulfur pollution. Heavy metals and trace elements - arsenic, cadmium, cobalt, chromium, copper, mercury, molybdenum, nickel, lead, selenium, vanadium, zinc, iron. Pesticide pollution. Land reclamation methods.

Practice:

Laboratory exercises and preparation of a term paper.

Literature:

Recommended:

1. M. Jakovljević, M. Pantović, Hemija zemljišta i voda, Naučna knjiga, Beograd, 1991.
2. V. Hadžić, M. Belić, LJ. Nešić, Praktikum iz pedologije, Poljoprivredni fakultet, Novi Sad, 2004.
3. L. Kolomejceva-Jovanović, Hemija i zaštita životne sredine, Savez inženjera i tehničara Srbije, Beograd, 2010.

Ancillary:

1. R. Kastori, I. Kadar, P. Sekulić, D. Bogdanović, M. Milošević, M. Pucarević, Uzorkovanje zemljišta i biljaka nezagađenih i zagađenih staništa, Naučni institut za ratarstvo i povrtarstvo, Novi Sad, 2006.
2. I. Molnar, D. Milošev, P. Sekulić, Agroekologija, Poljoprivredni fakultet, Novi Sad, 2003.
3. A.C. Duarte, A. Cachada, T. Rocha-Santos, Soil Pollution: From Monitoring to Remediation, Academic Press, 2018.
4. W.F. Bleam, Soil and Environmental Chemistry, Academic Press, 2018.
5. I. Mirsal, Soil Pollution: Origin, Monitoring & Remediation, Springer-Verlag Berlin Heidelberg, 2008.
6. A. Simonović, Praktikum iz zagađenja i zaštite zemljišta, Tehnički fakultet u Boru, Bor, 2018.

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

Teaching methods

Classical lectures with interactive discussions, laboratory exercises, consultations and colloquiums.

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	50
Colloquium exam/s			
Term paper	40		

Study program: Technological Engineering

Course: CHEMICAL PROCESS EQUIPMENT

Lecturer: PhD Jelena M. Đoković, full professor

Status of the course: Elective for Technological Engineering (compulsory for module ICT).

ECTS: 8

Prerequisite: Required knowledge of the basics of chemical technology, Mechanical operations, Heat transfer and motion operations and Thermodynamics.

Course goals: The educational goal of this course is to introduce students with the characteristics of equipment encountered in chemical plants.

Learning outcomes: Theoretical and practical knowledge about chemical process equipment.

Course description:

Lectures:

Introduction. Drivers for moving equipment. Equipment for preparation of raw material: Types of crushing equipment. Equipment for size separation of material: Gravity separators, Centrifugal air classifiers, Hydrocyclones, Screening devices. Mechanical separation equipment, Thickeners, Filtration equipment. Centrifugal separation equipment: Centrifugal equipment, Cyclones, Scrubbers. Mixing equipment. Drying: Drying equipment. Equipment for extraction and leaching: Extractors, Adsorption equipment. Heat exchange equipment. Heat devices. Cooling equipment. Fluid transport equipment.

Practice:

Numerical examples from all theoretical lectures.

Literature:

Recommended:

1. Printed materials for teaching.
2. N. Cheremisinoff, Handbook of Chemical Processing Equipment, Butterworth-Heinemann, Oxford, 2000.
3. S.M. Walas, Chemical Process Equipment, Butterworth-Heinemann series in chemical engineering, Newton, 1990.
4. R.K. Sinnott, Chemical Engineering, Volume 6, Fourth edition, Chemical Engineering Design, Elsevier, Oxford, 2005.

Ancillary:

1. J.M. Coulson and J.F. Richardson with J.R. Backhurst and J.H. Harker, Chemical Engineering, Volume 1, Sixth edition, Fluid Flow, Heat Transfer and Mass Transfer, Butterworth-Heinemann, Oxford, 1999.
2. J.F. Richardson and J.H. Harker with J.R. Backhurst, Chemical Engineering, Volume 2, Fifth edition, Particle Technology and Separation Processes, Butterworth-Heinemann, Oxford, 2002.

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

Teaching methods

Classic lectures with interactive discussions, practical classes, colloquiums, final exam.

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	60
Colloquium exam/s	10+10+10		
Term paper			

Study program: Technological Engineering

Course: POLLUTION AND AIR PROTECTION

Lecturer: PhD Snežana M. Šerbula, full professor

Status of the course: Elective for Technological Engineering (compulsory for module EE).

ECTS: 8

Prerequisite: Fundamentals knowledge of Heat and mass transport.

Course goals: Research the main methods for air protection in order to protect the atmosphere from the emission of technological air waste mixtures which are in limited values prescribed by the law.

Learning outcomes: Using the methods for purifying waste air mixtures due to environmental protection.

Course description:

Lectures:

Concept, types and sources of air pollution. Emission and transmission of air pollution. Regulatives of air quality. Air pollution test methods. The greenhouse effect. Acid rain. Depletion of the Earth's ozone layer. The impact of air pollution on humans. Physical methods for purification of polluted waste gases. Chemical and physico-chemical methods for purification of waste gases. Air quality monitoring. Protection of air from pollution. Biomonitoring.

Practice:

Air pollution monitoring and measuring stations.

Literature:

Recommended:

1. S. Šerbula, Ž. Grbavčić, Zagađenje i zaštita vazduha, Tehnički fakultet u Boru, Bor, 2011.
2. S. Šerbula, Zagađivanje i zaštita vazduha, Zavod za udžbenike, Beograd, 2009.

Ancillary:

1. D. Vallero, Fundamentals of Air Pollution, Academic Press, San-Diego, 2014.
2. J. Đuković, Hemija atmosfere, Rudarski institut Beograd, 2001.

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

Teaching methods

Classical lectures with interactive discussions, calculations and laboratory exercises, consultation and writing of term paper.

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
Colloquium exam/s	20		
Term paper	30		

Study program: Technological Engineering

Course: TECHNOLOGY OF NEW MATERIALS

Lecturers: PhD Marija B. Petrović Mihajlović, associate professor; PhD Ana A. Radojević, assistant professor

Status of the course: Elective for Technological Engineering (compulsory for module ICT).

ECTS: 5

Prerequisite: Acquired knowledge form Physical chemistry.

Course goals: Students learn the basic principles of interaction between structure, properties and processing materials, by studying the characteristic representatives of the basic classes of engineering materials: metals, ceramics, polymers, and composites used in chemical engineering.

Learning outcomes: Students master the theoretical knowledge that is necessary for understanding the properties of materials, their importance and the dependence of properties on the structure of the material and certain conditions of their obtaining. In addition, a critical way of thinking in the direction of choosing the most suitable materials of certain characteristics, as well as the method of obtaining and characterizing the material is adopted.

Course description:

Lectures:

The content of the course can be divided into two parts: (1) Properties and structure of materials; Classification of materials; Crystal structures; Crystal imperfections; Nonstoichiometric solid matter; Solid solutions; Liquid crystals; Vitreous state; Silicate structure; Silicate melts; Metal glasses; Crystallization; (2) Technologies for obtaining, characteristics and application of some classes of new materials: Methods for obtaining highly pure and amorphous metals; ESR; SHS-synthesis; Methods for obtaining single crystals; CVD; Smart materials; Semiconductors; Superconductors; Carbon nanotubes; Powder metallurgy; Sintering; Ceramics; Polymers; Biomaterials; Biomimetic materials.

Practice:

Laboratory exercises.

Literature:

Recommended:

1. M. Ristić, Principi nauke o materijalima, Srpska Akademija Nauka i Umetnosti, Beograd, 1993.
2. Lj.M. Nikolić, Uvod u materijale, Tehnološki fakultet, Novi Sad, 2014.
3. V.V. Srdić, Procesiranje novih keramičkih materijala, Tehnološki fakultet, Novi Sad, 2004.
4. Lj.M. Nikolić, V.V. Srdić, Osobine keramičkih materijala, Tehnološki fakultet, Novi Sad, 2011.
5. L. Matija, D. Kojić, A. Vasić, B. Bojović, T. Jovanović, Đ. Koruga, Uvod u nanotehnologije: Nanonauka, nanomaterijali, nanosistemi, primena, DON VAS/Nauka, Beograd, 2010
6. M. Mitkov, D. Božić, Z. Vujović, Metalurgija praha, BMG, Zavod za udžbenike i nastavna sredstva, Institut za nuklearne nauke „Vinča“, Beograd, 1998.
7. S. Putić, Mehanička svojstva polimernih kompozitnih materijala, TMF Beograd, 2005.
8. S. Nestorović, Sintermetalurgija, Praktikum, Tehnički fakultet u Boru, Bor, 2001.

Ancillary:

1. R.M. Rose, L.A. Shepard, J. Wulf, Struktura i osobine materijala – knjiga IV Elektronske osobine, Tehnološki fakultet, Novi Sad, 2002.
2. D. Raković, D. Uskoković, Biomaterijali, Institut tehničkih nauka Srpske akademije nauka i umetnosti, Društvo za istraživanje materijala, Beograd, 2010.
3. J.F. Shackelford, Introduction to Materials Science for Engineers, Pearson Prentice Hall, 2010.

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

Teaching methods

Classical lectures with interactive discussions, computational and laboratory exercises, consultations, colloquiums and preparation of term paper.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance	5	Written part of the final exam	
Exercise attendance	10	Oral part of the final exam	50
Coloquium exam/s	10		
Term paper	25		

Study programs: Technological Engineering

Course: WASTEWATERS

Lecturer: PhD Maja M. Nujkić, associate professor

Status of the course: Elective for Technological Engineering (compulsory for module EE).

ECTS: 5

Prerequisite: Acquired knowledge in the field of General chemistry, Inorganic chemistry and Physical chemistry.

Course goals: The aim of the course is to introduce students to the classification of wastewater, wastewater treatment and industrial methods for their purification and further treatment.

Learning outcomes: Obtaining the necessary engineering knowledge on modern technologies of processing industrial and municipal wastewater.

Course description:

Lectures:

Introductory part: classification of wastewater – by species, by composition, by way of formation; requirements for the degree of wastewater treatment – legal regulations, treatment options. Industrial methods for wastewater treatment: chemical methods (neutralization, precipitation, destructive methods), physico-chemical methods (adsorption, hemisorption – ion exchange), flotation processes, solvent extraction, membrane processes, electrochemical processes (reduction of metal ion, anode oxidation of organic compounds, electrodialysis), biochemical methods, combined processes. Basic and auxiliary wastewater treatment operations: separation of suspensions (thickening, clarification, filtration, drying). Sludge treatment.

Practice:

Laboratory exercises and working on independent work.

Literature:

Recommended:

1. V. Stanković, Transfer phenomena and operations in metallurgy 1 and 2, Technical faculty in Bor, 1998. (selected chapters).
2. D. Ljubisavljević, A. Đukić, B. Babić, Wastewater treatment, Civil Engineering, Beograd, 2004.
3. M. Stanojević, Treatment of drinking water, Civil Engineering, Beograd, 2009.
4. Water law, The Official Gazette of Republic of Serbia, No. 30/2010, 93/2012, 101/2016, 95/2018 and 95/2018.

Ancillary:

1. L. Benefield, J. Judkins, B. Weand, Process Chemistry for Water and Wastewater Treatment, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1982.
2. N. Gray, Water Technology, 3rd Ed., Elsevier Ltd., UK, 2010.
3. M. Henze, P. Harremoes, E. Arvin, J. Jansen, Wastewater Treatment, 3rd Ed., Springer-Verlag, Berlin Heidelberg, Germany, 2002.

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

Teaching methods

Classical lectures with interactive discussions, laboratory practicals and term paper.

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	50
Colloquium exam/s			
Term paper	40		

Study program: Technological Engineering

Course: WATER TECHNOLOGY

Lecturer: PhD Snežana M. Šerbula, full professor

Status of the course: Elective for Technological Engineering (module ICT).

ECTS: 6

Prerequisite: Fundamental knowledge of Momentum transport and Heat and mass transport.

Course goals: Consideration of technologies for water processing in order to obtain high quality water.

Learning outcomes: Acquire the knowledge necessary for the involvement in the technologies of obtaining drinking water.

Course description:

Lectures:

Water properties and quality. Atmospheric water. Surface water. Underground waters. Drinking water. Drinking water preparation. Aeration. Coagulation and flocculation. Filtration. Water purification by clarification and squeezing. Disinfection of drinking water, ozonization and chlorination. Ionic exchange. Desalinisation of seawater. Water for industrial purposes. Water preparation for industrial purposes. Water softening. Thermal procedures. Chemical methods. Wastewater. Water protection legislation. Biological purification of water.

Practice:

Writting and defense of an individual term paper.

Literature:

Recommended:

1. Š. Goletić, N. Imamović, N. Avdić, Obrada otpadnih voda, Univerzitet u Zenici, 2014.
2. M. Stanojević, Tretman pijaće vode, Građevinska knjiga, Beograd, 2013.
3. M. Šćiban, Biosorpcija teških metala iz vode, Tehnološki fakultet, Novi Sad, 2013.

Ancillary:

1. N.P. Cheremisinoff, Handbook of Water and Wastewater Treatment Technologies, Butterworth-Heinemann, 2002.

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 colloquium.

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	30
Colloquium exam/s			
Term paper	50		

Study program: Technological Engineering

Course: MATERIALS CORROSION

Lecturer: PhD Marija B. Petrović Mihajlović, associate professor

Status of the course: Elective for Technological Engineering (module ICT).

ECTS: 6

Prerequisite: Acquired knowledge form Physical chemistry.

Course goals: Students are introduced to methods of corrosion processes testing, corrosion of basic metalic and non-metallic materials, as well as measures of those materials protection.

Learning outcomes: Students are trained to work on the analysis of corrosion processes and the protection of certain materials that are used in technological processes.

Course description:

Lectures:

Examination of corrosion processes. Laboratory, field and exploitation tests. Optical, gravimetric, mechanical, electrical and electrochemical testing methods. Other methods of examinations. Corrosion of iron and steel. Corrosion of copper and brass. Corrosion of aluminum and other important technical materials based on metals and alloys. Metal corrosion inhibitors. Corrosion of non-metallic materials. Corrosion of materials under operating conditions. Analyzes of technological processes from the aspect of material corrosion. Selection of construction materials and protection measures.

Practice:

Laboratory exercises and preparation of a seminar paper.

Literature:

Recommended:

1. M.G. Fontana, N.D. Greene, Corrosion Engineering, McGraw-Hill, New York, 1984.
2. N. Radošević, ur., O. Tatić-Janjić, red., Hemijsko-tehnološki priručnik VI – korozija i zaštita Materijala, Rad, Beograd, 1985.
3. S. Mladenović, M. Pavlović, D. Stanojević, Korozija i zaštita betona i armiranog betona, SISZAM, Beograd, 2008.
4. M.G. Pavlović, D. Stanojević, S. Mladenović, Korozija i zaštita materijala, Tehnološki fakultet, Zvornik, 2012.
5. Z. Gulišija, Č. Lačnjevac, Korozija i zaštita materijala, ITNMS, IDK, Beograd, 2012.

Ancillary:

1. L.L. Shreir, R.A. Jarman, Corrosion – Metal/Environmental reactions, Butterworth-Heinemann, Oxford, 2000.
2. S. Đorđević, Metalne prevlake, Savremena administracija, Beograd, 1970.
3. V. Mišković-Stanković, Metalne i nemetalne prevlake, Praktikum za vežbe, Tehnološkometalurški fakultet, Beograd, 2001.
4. V. Mišković-Stanković, Organske zaštitne prevlake, SITZAMS, Beograd, 2001.
5. M.B. Petrović Mihajlović, M.M. Antonijević, Inhibitori korozije bakra, Tehnički fakultet u Boru, Bor, 2017.
6. M. Radovanović, M. Antonijević, Ekološki prihvatljivi inhibitori korozije bakra i čelika, Grafomed, Bor, 2022.

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

Teaching methods

Classical lectures with interactive discussions, laboratory exercises, consultations and preparation of term paper.

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	30
Colloquium exam/s			
Term paper	50		

Study program: Technological Engineering

Course: CERAMICS TECHNOLOGY

Lecturer: PhD Snežana M. Milić, full professor; PhD Milan B. Radovanović, associate professor

Status of the course: Elective for Technological Engineering (module ICT).

ECTS: 6

Prerequisite: Required knowledge of General chemical technology.

Course goals: Students are introduced to technologies for obtaining basic building materials.

Learning outcomes: Students are trained to work in plants for the production of construction materials, as well as to test the properties of those materials.

Course description:

Lectures:

During the course, the processes that are an integral part of the technological scheme of the production of traditional and modern ceramics are covered. The following topics are covered: types and preparation of raw materials for traditional ceramics, chemical processes for the synthesis of raw materials for modern ceramics, molding processes in ceramic technology, powder pressing, molding of plastic dough, molding in traditional and modern ceramics, drying in ceramic technology, sintering of traditional and modern ceramics materials, kilns and kilns in ceramic technology, glazing, application of pigments in ceramic technology.

Practice:

Laboratory exercises and preparation of a term paper.

Literature:

Recommended:

1. V. Srdić, Procesiranje novih keramičkih materijala, Tehnološki fakultet, Novi Sad, 2004.
2. M. Tecilazić-Stevanović, Osnovi tehnologije keramike, Tehnološko-metalurški fakultet, Beograd, 1990.
3. Lj. Kostić-Gvozdenović, M. Todorović, R. Petrović, Praktikum iz tehnologije keramike, Tehnološko-metalurški fakultet, Beograd, 2000.

Ancillary:

1. J. Hlaváč, The Technology of Glass and Ceramics, An Introduction, Elsevire Scientific Publishing company, Amsterdam-Oxford-New Zork, 1983.
2. Đ. Janaćković, Keramički materijali u sistemu Al_2O_3-MgO-SiO_2. Deo 1. Spinel, mulit, kordijerit: sinteza, svojstva, primena, Tehnološko-metalurški fakultet, Beograd, 2004.

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

Teaching methods

Classic lectures with interactive discussions, computational and laboratory exercises, consultations and preparation of a term paper.

Knowledge evaluation (maximum points 100)

Pre-examination obligations	Points	**Final exam**	Points
Lecture attendance		Written part of the final exam	
Exercise attendance	10	Oral part of the final exam	50
Colloquium exam/s			
Term paper	40		

Study program: Technological Engineering

Course: GLASS TECHNOLOGY

Lecturers: PhD Snežana M. Milić, full professor; PhD Marija B. Petrović Mihajlović, associate professor

Status of the course: Elective for Technological Engineering (module ICT).

ECTS: 6

Prerequisite: Acquired knowledge of General chemical technology.

Course goals: Acquaintance of students with the properties and physico-chemical foundation of glass synthesis.

Learning outcomes: Students are trained to work in glass production facilities.

Course description:

Lectures:

Classification of glass. Vitreous state. Glass structure. Properties of glass. Physico-chemical basis of glass synthesis. Raw materials. Melting processes. Forming processes. Cooling. Finishing processes. Errors/imperfections in the glass. Technological processes. Calculations.

Practice:

Computational calculations, laboratory exercises and preparation of a seminar paper.

Literature:

Recommended:

1. V.V. Srdić, Procesiranje novih keramičkih materijala, Tehnološki fakultet, Novi Sad, 2004.
2. M. Tecilazić-Stevanović, Osnovi tehnologije keramike, Tehnološko-metalurški fakultet, Beograd, 1990.
3. M. Jovanović, Lj. Kostić-Gvozdenović, N. Blagojević, Praktikum iz tehnologije stakla, Tehnološko-metalurški fakultet, Beograd, 1997.

Ancillary:

1. J.E. Shelby, Introduction to Glass Science and Technology, RSC, Cambridge, 1997.
2. H. Ylanen, Bioactive Glasses: Materials, Preparation and Applications, 2nd Ed., Elsevier, 2017.
3. J-L. Adam, X. Zhang, Chalcogenide Glasses: Preparation, Properties and Applications, Woodhead Publishing, 2014.
4. B. Karmakar, Functional Glasses and Glass-ceramics: Processing, Properties and Applications, Elsevier, 2017.

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

Teaching methods

Classical lectures with interactive discussions, laboratory and calculation exercises, consultations and preparation of term paper.

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	50
Colloquium exam/s			
Term paper	40		

Study program: Technological Engineering

Course: FUNDAMENTALS OF VACUUM AND PLASMA PHYSICS

Lecturer: PhD Čedomir A. Maluckov, full professor

Status of the course: Elective for Technological Engineering study program (module ICT)

ECTS: 6

Prerequisite: Acquired knowledge in the fields of Physics, Physical Chemistry and Fundamentals of Electrical Engineering.

Course goals: Acquisition of basic theoretical knowledge about physical processes in vacuum, vacuum measurement and applications of vacuum in technology and industry. Acquisition of basic theoretical knowledge of plasma physics, plasma production and its use in technology and industry.

Learning outcomes: Students are introduced to various basic properties of vacuum, measurement and application of vacuum systems. They become familiar with the basics of plasma physics and the use of plasma in industry. At the end of the course, students have the basic knowledge to work with vacuum systems and devices that work on the principle of plasma physics.

Course description:

Lectures:

Fundamentals of vacuum physics. Ideal and real gases. Flow of gases. Sorption and desorption. Obtaining a vacuum. Low vacuum pumps, oil and oil-free. High vacuum pumps. Diffusion and cryogenic vacuum pumps. Vacuum measurement. Importance of vacuum in industry and technology.

Basics of plasma physics. Non-independent and independent discharge. Glow discharge. Arc discharge. Corona discharge. High frequency discharge. Inductively and capacitively coupled discharges.

Applications of plasma in technology and industry. Interaction of discharge with surfaces. Plasma deposition. Hard covers. Thermal barriers. Multi-component and multi-layer coatings. Combined plasma deposition and plasma nitrification. Plasma cutting. Plasma welding. Air purification using plasma. Plasma separation of solid waste.

Practice:

Laboratory exercises. Making a seminar paper.

Literature:

Recommended:

1. W. Umrath, Fundamentals of Vacuum Technology, Oerlikon Leybold Vacuum, Cologne, June 2007.
2. B.M.Smirnov, Physics of Ionized Gases, John Wiley and Sons, New York2001.
3. Yu. P. Raizer. Gas Discharge Physics. Springer, Berlin, New York, 1997.
4. J. Harry, Introduction to Plasma Technology-Science, Engineering and Applications, Wiley-VCH Verlag GmbH&Co. KGaA, Weinheim, 2010.

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

Teaching methods

Classic lectures with interactive discussions, laboratory exercises, consultations and colloquiums.

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	40
Coloquium exam/s	30		
Term paper	20		

Study program: Technological Engineering

Course: TECHNOLOGY OF SOLID WASTE TREATMENT AND DISPOSAL

Lecturer: PhD Ana A. Radojević, assistant professor

Status of the course: Elective for Technological Engineering (module EE).

ECTS: 6

Prerequisite: The basic knowledge in a field of ecology and environmental protection**.**

Course goals: Students will be introduced to the main categories of solid waste, the negative impact of solid waste on the environment, in addition to adequate disposal methods and technologies for processing of different types of solid waste.

Learning outcomes: Students will master the theoretical knowledge related to the adequate solid waste disposal and recycling technologies for obtaining secondary raw materials or utilization of waste for production of heat or electrical energy. Through independent work, students will master the research skills by using scientific databases in order to find and select scientific data in a certain field of research.

Course description:

Lectures:

Sources and composition of solid waste. Physical, chemical and biological properties of solid waste. Types of waste according to its origin, toxicity and composition. Current waste legislation in the world and in the Republic of Serbia. Solid waste management at source. Collection, sorting and transportation of solid waste. Methods of treatment (physical, chemical and biological) of solid waste. Utilization of waste for heat or electrical energy production or obtaining compost. Recycling of waste and obtaining useful products. Economic and ecological aspects of recycling. Sanitary landfills, construction, air, soil and water quality control at the landfill. Integrated solid waste management.

Practice:

Laboratory work. Preparation of term paper based on the student's independent research work.

Literature:

Recommended:

1. M. Ristić, M. Vuković, Upravljanje čvrstim otpadom, Grafomed-trade, Bor, 2006.
2. J. Sredojević, Reciklaža otpada, Mašinski fakultet, Zenica, 2006.
3. J. Sredojević, Obrada i deponije otpada, Mašinski fakultet, Zenica, 2006.
4. F.R. McDougall, P.R. White, M. Franke, P. Hindle, Integrated Solid Waste Management: a Life Cycle Inventory, 2nd Ed., Blackwell Science, Oxford, UK, 2003.
5. G. Tchobanoglous, F. Kreith, Handbook of Solid Waste Management, 2nd Ed., McGraw-Hill, USA, 2002.

Ancillary:

1. D. Knežević, S. Torbica, Z. Rajković, M. Nedić, Odlaganje industrijskog otpada, Rudarsko-geološki fakultet, Beograd, 2014.
2. E. Worrell, M. A. Reuter, Handbook of Recycling, State-of-the-Art for Practitioners, Analysts, and Scientists, Elsevier, Amsterdam, 2014.
3. A. Chagnes, G. Cote, C. Ekberg, M. Nilsson, T. Retegan, WEEE Recycling, Research, Development, and Policies Elsevier, Amsterdam, 2016.
4. N. Rudolph, R. Kiesel, C. Aumnate, Understanding Plastics Recycling Economic, Ecological, and Technical Aspects of Plastic Waste Handling, Hanser Publishers, Munich, 2017.

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

Teaching methods

Classical lectures with interactive discussions, consultations and preparation of term paper.

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	40
Colloquium exam/s			
Term paper	50		

Study program: Technological Engineering

Course: PURIFICATION OF WASTE GASES

Lecturer: PhD Snežana M. Šerbula, full professor

Status of the course: Elective for Technological Engineering (module EE).

ECTS: 6

Prerequisite: The basic knowledge of Air pollution and protection.

Course goals: Research the main methods for purifying of waste industrial gases in order to emit gases in the atmosphere with the content similar to the air composition.

Learning outcomes: Using the gas purification methods in order to protect the environment.

Course description:

Lectures:

Introductory part: classification of industrial gases by the industry type, composition, quantities. Properties of gases. Gas flow models. Fundamentals of the two-phase system (gas-aerosol) mechanics. Fundamentals of the three-phase system mechanics. Methods for gases purification. Purification of gases from the particles dispersed in gas. Separation of solid phase particles dispersed in gas under the influence of external force – in the gravitational, centrifugal and electrostatic field of force. Filtration of gases and purification of condensed systems. Gases purification devices which work under the influence of external force. Removing of gas/steam components from the industrial gases. Absorption. Equilibrium in the gas-liquid system; differential and stepwise absorption systems. Absorbers. Adsorption. Equilibrium in the gas-solid system. Adsorbents. Molecular sieves. Removing of moisture from the industrial gases; condensation and condensers; draying of gases. Ion exchange.

Practice:

Designing and processing of an individual project.

Literature:

Recommended:

1. N. Avdić, Š. Goletić, N. Imamović, Tehnički sistemi za prečišćavanje otpadnih plinova, Univerzitet u Zenici, Zenica, 2013.
2. M. Bogner, M. Stanojević, L. Livo, Prečišćavanje i filtriranje gasova i tečnosti – teorija i računski primeri iz prakse, ETA, Beograd, 2006.

Ancillary:

1. A. Kohl, R. Nielsen, Gas Purification, Gulf Publishing Company, Houston, Texas, 1997.

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

Teaching methods

Classical lectures with interactive discussions, computational and laboratory exercises, consultations and term paper.

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	30
Coloquium exam/s			
Term paper	50		

Study program: Technological Engineering

Course: HAZARDOUS ORGANIC SUBSTANCES

Lecturer: PhD Slađana Č. Alagić, full professor

Status of the course: Elective for Technological Engineering (module EE).

ECTS: 6

Prerequisites: Fundamental knowledge on basic classes of organic compounds.

Course goal: Introduction with the hazardous organic substances, which are commonly emitted into the environment, especially regarding their eco-toxicological characteristics (reactivity, flammability, toxicity, and explosion potential). Basic information on their detection and remediation.

Learning outcomes: Students will be able to analyze and identify organic pollutants as well as to suggest adequate environmental protective procedures.

Course description:

Lectures:

The sources of pollution and the classification of organic pollutants. Persistent organic pollutants: pesticides and their metabolites, polychlorinated biphenyls and phthalates, polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans, polybrominated organic compounds, organic solvents and detergents, aliphatic and aromatic hydrocarbons, polycyclic aromatic hydrocarbons. The influence of organic pollutants on plant and animal life; the influence on humans (systemic, acute, and chronic effects). The pollution of air, ground and underground water, soil and protection treatments. Remediation methods. Physical, chemical, and microbiological methods for organic pollutants identification and evaluation, with special accent on the utilization of modern instrumental methods in their environmental monitoring.

Practice:

Identification of hazardous potential on the basis of physical, physic-chemical, and toxicological characteristics. GC/MS analysis of persistent organic pollutants. The identification of source of pollution. Formulation of planes for statistical analyses. Independent work.

Literature:

Recommended:

1. Power-Point presentation of the lecturer.
2. J.G. Speight, Environmental Organic Chemistry for Engineers, Elsevier Inc., 2017.
3. C.H. Walker, Organic Pollutants: An Ecotoxicological Perspective, 2nd Ed., Taylor & Francis Group, LLC, 2009.
   G. O'Sullivan, C. Sandau, Environmental Forensics for Persistent Organic Pollutants, Elsevier B.V., 2014.
4. O. Stojanović, N. Stojanović, Đ. Kosanović, Opasne i štetne materije, Rad, Beograd, 1986.
5. S.M. Milosavljević, Strukturne instrumentalne metode, Univerzitet u Beogradu, Hemijski fakultet, Beograd, 1994.

Ancillary:

1. F. Carson, C. Mumford, Hazardous chemicals handbook, Butterworth-Heinemann, Oxford, 2002.

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

Teaching methods

Teaching with interactive discussions, experimental work and calculations, consultations, and term paper.

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	30
Colloquium exam/s			
Term paper	50		

Study program: Metallurgical Engineering and Technological Engineering

Course: METALLURGY OF THE SECONDARY RAW MATERIALS

Lecturer: PhD Nada Štrbac, full professor

Status of the course: Elective for Metallurgical Engineering (module EM); Elective for Technological Engineering (module EE).

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.
2. I. Ilić, Z. Gulišija, M. Sokić, Reciklaža metaličnih sekundarnih sirovina, ITNMS, Beograd, 2010.
3. M.Vojinović i dr. Prerada otpadnih olovnih akumulatora u ekološki povoljnim uslovima, DIT EP, Beograd, 2004.

Ancillary:

1. Ilić i dr., Resursi i reciklaža sekundarnih sirovina obojenih metala, Institut za bakar, Bor, 2002.
2. R.Vračar, LJ. Jakšić, Sekundarna metalurgija olova, Fakultet tehničkih nauka Kosovska Mitrovica, 2001.
3. S.R. Rao, Resource Recovery and Recycling from Metallurgical Wastes, Elsevier, Amsterdam, 2006.
4. И. Хайдуков, Металургија вторичних цветних металов, Москва, Металургија, 1987.

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: Technological Engineering

Course: PHYSICAL SOURCES OF HARMFULNESS AND ENVIRONMENTAL PROTECTION

Lecturer: PhD Čedomir A. Maluckov, full professor

Status of the course: Elective for Technological Engineering study program (module EE)

ECTS: 6

Prerequisite: Acquired knowledge in the fields of Physics, Physical Chemistry and Fundamentals of Electrical Engineering.

Course goals: Acquiring basic theoretical knowledge about electromagnetic radiation and noise and the basic principles of their harmful effects.

Learning outcomes: Students are introduced to different types of application of noise and radiation sources, as well as the basic principles of protection against them. At the end of the course, students are trained to apply all elements of the noise and radiation protection program in the capacity of working with these sources and as persons in charge of protection against their harmful effects.

Course description:

Lectures:

Noise and vibration.Theoretical analysis of vibration and noise. Frequency spectrum of noise. Units for measuring sound level (noise). Harmful psychophysiological effects of noise. Instruments and methods of measuring vibration and noise. Instruments and methods of noise measurement. Frequency analyzers.

Thermal Radiation. Measurement and assessment of the harmful effects of thermal radiation. Microclimatic parameters. The concept of comfort, effective temperature as a criterion of comfort. Radiation of visible light. Physical and physiological photometric quantities. Brightness measurement and analysis. Ultraviolet radiation. Harmful effect and protection.

Non-ionizing electromagnetic radiation. Electromagnetic field energy. Earth's electric and magnetic field. Harmful effect of electrostatic fields. Electromagnetic radiation of electronic devices Infrared (heat) radiation.

Ionizing radiation. X-ray radiation. Alpha, beta, gamma and neutron radiation. Sizes and units. Harmful effect. Radiation dosimetry. Biological effects of radiation. Restoration after radiation. Biological effects of radiation. Contamination and decontamination. Management of radioactive waste.

Practice:

Laboratory exercises. Preparation of seminar papers

Literature:

Recommended:

1. M. P. Norton School of Mechanical Engineering, University of Western Australia and D. G. Karczub, Fundamentals of Noise and Vibration Analysis for Engineers Second edition, Cambridge University Press, 2003.
2. A.W. Wood, K. Karipidis, Non-ionizing Radiation Protection, John Wiley & Sons Inc., 2017.
3. Committee on the Biological Effects of Ionizing Radiations, Health Effects of Exposure to Low Levels of Ionizing Radiation, NATIONAL ACADEMY PRESS, Washington, D.C.1996.
4. Thormod Henriksen and H. David Maillie, Radiation and Health, Taylor & Francis, New York, 2003.

Ancillary:

3. Scientific works and various technical instructions.

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

Teaching methods

Classic lectures with interactive discussions, laboratory exercises, seminar papers, consultations and colloquiums.

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	40
Coloquium exam/s	30		
Term paper	20		

Study program: Technological Engineering				
Course: INTERNSHIP PROFESSIONAL PRACTICE				
Lecturers: PhD Milan B. Radovanović, associate professor; PhD Žaklina Z. Tasić, associate professor				
Status of the course: Compulsory for Technological Engineering.				
ECTS: 3				
Prerequisite: Enrolled in the eighth semester.				
Course goals: The goal of professional practice is for students to get to know and gain practical knowledge related to the technological processes of obtaining various products and about the represented technological operations. The practice will enable them to see the impact of technological processes on the environment.				
Learning outcomes: Enabling students to recognize and apply previously acquired theoretical knowledge in real industrial production processes. By sublimating the theoretical knowledge acquired in teaching activities and the practical knowledge achieved through the implementation of professional practice, students acquire new quality and competences for better understanding, more efficient studying and independent preparation of the final paper.				
Course description: Observing and recording the operational characteristics of process equipment used in technological processes. Reviewing the characteristics of raw materials, energy consumption, technological procedures, product quality, as well as the impact of technological processes on the living and working environment. Acquaintance with the procedures of planning and organization of work in order to optimize the performance of certain technological operations. Getting to know the methods of quality control of production systems.				
Number of classes per week	**Lectures:**	**Practical classes: 6**	**Study research work:**	**Other forms of teaching:**
Teaching methods Practical work or professional practice in a company or institution is carried out according to a pre-defined program - a task consisting of data collection - measurement and analysis with consultation with experts from the company where the professional practice is carried out and the teacher - professional practice coordinator. At the end of the professional practice, the student submits to the professional practice coordinator a written diary with a description of the activities and jobs he performed during the professional practice. The teacher - professional internship coordinator confirms with his signature in the index that the student has successfully completed the professional internship, which enables the student to certify the semester with other signatures.				
Knowledge evaluation (maximum 100 points)				
Pre-examination obligations	Points	**Final exam**	Points	
Attendance at professional practice	50	Defense of professional practice	50	

Study program: Technological Engineering

Course: BACHELOR THESIS – RESEARCH

Lecturers: All lecturers of the study Program are potential mentors

Status of the course: Compulsory for Technological Engineering.

ECTS: 2

Prerequisite: Submitted topic of the Bachelor thesis.

Course goals: In the Bachelor's thesis students describe technologies or scientific and professional issues in the field of inorganic chemical technology, environmental protection and narrow professional courses. Bachelor thesis could be based on the specific data obtained by experimental work which corresponds to the given submitted topic, under the guidance of the mentor. Afterwards, the collected data are analyzed and discussed by comparing to the corresponding data from the scientific literature. Also, Bachelor thesis could be in the review form based on the analysis of the data from the scientific literature with the aim of describing of the specific topic. By searching of available scientific and expert databases, students collect information on the given specific topic. Final paper is submitted in the written form and defended in front of a commission consisted of three members. Final paper is the last exam of the study Program.

Learning outcomes: The expected results of the Bachelor's thesis are acquainting with the topic matter and the way of solving it, along with the practical application of the acquired knowledge from the study Program, which enables the student to independently solve the engineering tasks within the framework of the study Program.

Course description:

The final paper is a research work formulated for each individual student, in which student becomes acquainted with the research methodology in the field of Technological engineering. The mentor guide the candidate during student's work and provides the assistance in the entire process of: choosing the topic of final paper, formulation of the thesis title, setting the goal of the thesis, engineering methods and the ways of solving it, approach to the problem, the choice of solving problems, data collection, processing and verification with applying engineering methods, and final design of the final paper.

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

Teaching methods

The methods of performing the Bachelor thesis consist of a theoretical introduction to the problem and independent laboratory work under the supervision of lecturers. During the research within the Bachelor thesis, all necessary research methods will be applied. Upon completion of the work and its positive assessment by the mentor, the candidate will orally defend the thesis in front of the three-member commission.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Bachelor thesis – research	50	Bachelor thesis – research	50

Study program: Technological Engineering

Course: BACHELOR THESIS – PREPARATION AND DEFENSE

Lecturers: All lecturers of the study Program are potential mentors

Status of the course: Compulsory for Technological Engineering.

ECTS: 2

Prerequisite: Passed all exams provided for in the program of basic academic studies of the Technological Engineering study program and realized professional practice.

Course goals: In the Bachelor's thesis, students describe technologies or scientific and professional issues in the field of inorganic chemical technology, environmental protection and narrow professional subjects, using data obtained during professional practice. Students are searching for available scientific and expert databases or experiments, and complete information on the given topic and submit a final paper defending it in front of a commission of three members. Final paper is the final exam in the study Program.

Learning outcomes: The expected results of the Bachelor's thesis are acquainting with the subject matter and the way of solving it, along with the practical application of the acquired knowledge from the study Program, which enables the student to independently solve the engineering tasks within the framework of the study Program.

Course description: After the research, the student prepares final work in the form that contains the following chapters: introduction (defining the goal of the task and the expected results); theoretical part (an overview of the most important theoretical bases, which are the basis for certain research); experimental, practical part (concrete processing of a given engineering problem), results and discussion (presentation of obtained results in the unfinished technical form, with necessary comments and conclusions given in order to solve the current problem), and literature review.

After completing of Bachelor's thesis, the student submits it to the mentor, and then having public defense of the thesis. This way, student qualifies for independent exibition and defense of acquired engineering knowledge and experience.

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

Teaching methods

The methods of performing the final work consist of a theoretical introduction to the problem and independent laboratory work under the supervision of teachers. During the final work, all necessary research methods will be applied. Upon completion of his work and his positive assessment by the mentor, the candidate will orally defend the work before the three-member teacher commission.

Knowledge evaluation (maximum 100 points)

Pre-examination obligations	Points	**Final exam**	Points
Bachelor thesis – preparation and defense	50	Bachelor thesis – preparation and defense	50