ВИСОКА ТЕХНИЧКА ШКОЛА
СТРУКОВНИХ СТУДИЈА
у Новом Саду

# COURSE CATALOGUE

# MECHANICAL ENGINEERING

## Undergraduate applied studies

**NOVI SAD**
**May 2023**

## Table 5.2.a – Course catalogue of the MECHANICAL ENGINEERING undergraduate study programme

| No. | Course code | Course title | Field of Study | Semester | Lecture | Lab | Other Forms of Teaching | Other Hours | ECTS |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2002 | Mathematics | Mathematical Sciences, Technological Engineering | I | 2 | 3 | 0 | 0 | 7 |
| 2 | 2003 | Physics | Physical Siences | I | 2 | 2 | 0 | 0 | 6 |
| 3 | 2022 | Technical drawing with descriptive geometry | Mechanical Engineering, Technological Engineering | I | 2 | 2 | 0 | 0 | 6 |
| 4 | 2010 | Fundamentals of computing | Electrical and Computer Engineering, Technological engineering | I | 1 | 1 | 1 | 0 | 6 |
| 5 | Elective option 1 (select 1 of 2) | | | | | | | | |
| | 2001 | Business communications | Cultural Studies and Communications, Applied Arts and Design | I | 3 | 1 | 0 | 0 | 6 |
| | 2132 | Business law | Legal Sciences | I | 3 | 1 | 0 | 0 | 6 |
| 6 | 2035 | Engineering communications | Mechanical Engineering | II | 2 | 1 | 1 | 0 | 6 |
| 7 | 2065 | Metal forming processes | Mechanical Engineering | II | 2 | 1 | 1 | 0 | 5 |
| 8 | 2034 | Computer-aided design | Mechanical Engineering | II | 2 | 1 | 1 | 0 | 6 |
| 9 | 2033 | Mechanics | Mechanical Engineering | II | 2 | 3 | 0 | 0 | 6 |
| 10 | 2031 | Strength of materials | Mechanical Engineering | II | 3 | 1 | 0 | 0 | 6 |
| 11 | 2036 | Elements of automation | Mechanical Engineering | III | 2 | 2 | 0 | 0 | 6 |
| 12 | 2039 | Quality management | Mechanical Engineering, Technological Engineering | III | 2 | 2 | 0 | 0 | 6 |
| 13 | 2032 | Fundamentals of energy systems | Mechanical Engineering | III | 2 | 2 | 0 | 0 | 7 |
| 14 | 2038 | Engineering materials | Mechanical Engineering, Physical Sciences | III | 2 | 3 | 0 | 0 | 6 |
| | Elective option 2 (select 1 of 2) | | | | | | | | |
| 15 | 2006 | Fundamentals of electrical engineering 1 | Electrical and Computer Engineering | III | 2 | 2 | 0 | 0 | 6 |
| | 2013 | Combustion processes | Chemical Sciences | III | 2 | 2 | 0 | 0 | 7 |
| 16 | 2015 | English | Philological Sciences | IV | 2 | 0 | 0 | 0 | 3 |
| 17 | 2040 | Fundamentals of maintenance | Mechanical Engineering | IV | 2 | 2 | 0 | 0 | 6 |
| 18 | 2041 | Machine elements | Mechanical Engineering | IV | 3 | 2 | 0 | 0 | 7 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 19 | 2101 | Machine tools | Mechanical Engineering | IV | 2 | 2 | 1 | 0 | 7 |
| | Elective option 3 (select 1 of 2) | | | | | | | | |
| 20 | 2008 | Process devices | Technological Engineering, Environmental and Occupational Safety Engineering | IV | 2 | 3 | 0 | 0 | 7 |
| | 2098 | Engines and motor vehicles | Mechanical Engineering | IV | 2 | 1 | 1 | 0 | 6 |
| 21 | 2019 | Technical systems management | Technological Engineering, Organizational Sciences | V | 2 | 2 | 0 | 0 | 6 |
| 22 | 2018 | Specialist English | Philological Sciences | V | 2 | 0 | 0 | 0 | 3 |
| 23 | 2042 | Modelling and 3D printing | Mechanical Engineering; Technological Engineering | V | 3 | 1 | 1 | 0 | 7 |
| 24 | Elective option 4 (select 1 of 2) | | | | | | | | |
| | 2078 | Graphic processes | Technological Engineering, Mechanical Engineering | V | 3 | 1 | 1 | 0 | 7 |
| | 2023 | Work equipment safety | Environmental and Occupational Safety Engineering, Mechanical Engineering | V | 2 | 3 | 0 | 0 | 7 |
| 25 | Elective option 5 (select 1 of 2) | | | | | | | | |
| | 2102 | Machine tool programming | Mechanical Engineering | V | 3 | 2 | 0 | 0 | 7 |
| | 2026 | Air, water and soil protection | Environmental and Occupational Safety Engineering | V | 3 | 1 | 1 | 0 | 7 |
| 26 | 2106 | Work practicum | Legal Sciences, Environmental and Occupational Safety Engineering, Cultural Studies and Communications | VI | 4 | 4 | 0 | 0 | 7 |
| 27 | 2107 | Theoretical and experimental bases of professional work | Mechanical Engineering, Electrical and Computer Engineering, Cultural Studies and Communications | VI | 6 | 4 | 0 | 0 | 9 |
| 28 | 2117 | Professional practice | Mechanical Engineering | VI | 0 | 0 | 0 | 6 | 4 |
| 29 | 2137 | Preliminary thesis | Mechanical Engineering | VI | 0 | 0 | 0 | 0 | 2 |
| 30 | 2138 | Final thesis | Mechanical Engineering | VI | 0 | 0 | 0 | 3 | 8 |

Back to top

## Table 5.2. – Course Specification

| | | | |
|---|---|---|---|
| **Study programme: Mechanical engineering** | | | |
| **Course title: Mathematics** | | | |
| **Teacher: Tanja Krunić** | | | |
| **Course status: Compulsory** | | | |
| **Number of ECTS: 7** | | | |
| **Prerequisite course: None** | | | |
| **Course objective**<br>Introduction to and mastery of basic concepts in specific areas of mathematics. Preparing students to apply mathematical methods to solve problems in basic and applied sciences. | | | |
| **Learning outcomes**<br>Students will acquire fundamental knowledge in mathematical logic and algebra, set theory, differential, and integral calculus. Students will be equipped to follow courses in professional fields that apply the concepts and techniques they have mastered, and to recognize problems where they can apply the acquired knowledge. | | | |
| **Course contents**<br>*Theoretical teaching*<br>Basic concepts of mathematical logic. Sets - basic concepts. Complex numbers: concept, properties, operations. Matrices: Concept of a matrix and matrix operations. Determinants. Inverse matrix. Systems of linear equations. Matrix rank. Real functions of real variables: Domain, zeros, sign of function, boundedness, periodicity, parity. Basic elementary functions: linear, quadratic, power, radical, exponential, logarithmic, trigonometric functions, inverse trigonometric functions. Polynomials. Rational functions. Sequences, limit of a sequence. Continuity of a function. Limits of functions. Asymptotes of functions. Derivatives: Concept of a derivative, differentiation rules, derivatives of basic elementary functions, derivative of composite function, higher-order derivatives. Differential of a function. L'Hôpital's rule. Intervals of monotonicity and extreme values. Convex and concavity intervals, inflection points. Curve sketching and function analysis. Indefinite integral: Concept, table of integrals and basic integration methods. Definite integral. Application of the definite integral.<br>*Practical teaching*<br>Solving problems that illustrate the concepts and their interrelationships covered in the theoretical part of the course. Formulating and solving practical mathematical problems. | | | |
| **Literature**<br>Krunić T., Skripta iz matematike u elektronskom obliku, 2017<br>Petrić M., Herceg D., Matematika, Visoka tehnička škola strukovnih studija u Novom Sadu, Novi Sad, 2010<br>Prentović B., Matematika – zbirka zadataka, Visoka tehnička škola strukovnih studija u Novom Sadu, Novi Sad, 2016 | | | |
| **Active teaching classes: 75** | **Theoretical teaching: 30** | **Practical teaching: 45** | |
| **Teaching methods**<br>Monologic, dialogic, interactive. | | | |
| **Assessment (maximum number of points 100)** | | | |
| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Physics**

**Teacher: Vesna Petrović**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

Introduction to the fundamental laws of selected fields of physics: mechanics with hydromechanics, thermophysics, as well as geometric and wave optics. Students become familiar with the scope of individual laws and their application in ideal and real cases.

**Learning outcomes**

Students know and can apply basic physical laws from selected areas (calculate the velocities of bodies and fluids, and apply gas laws as well as the laws of geometric and wave optics). They know how to measure specific physical parameters of liquids, verify gas laws, and determine certain optical parameters. They can later apply this knowledge with understanding in professionally applied courses and practice.

**Course contents**

*Theoretical teaching*

Introduction: International System of Units (SI). Scalar and vector quantities in physics. Basic algebraic operations with vectors.
Kinematics: Motion in space. Velocity and acceleration. Linear and curvilinear motion.
Dynamics: Newton's laws of motion. Force and impulse of a force. Work, power, and energy. Conservation laws. Dynamics of rigid body rotation.
Fluid Mechanics: Properties of liquids. Hydrostatic pressure. Pascal's and Archimedes' laws. Capillary phenomena. Properties of gases. Barometric formula. Steady flow of an ideal fluid. Continuity equation. Bernoulli's equation and its applications. Viscosity and viscous drag. Reynolds number. Bernoulli's equation for real fluids.
Thermophysics: Kinetic theory of gases: Fundamental principles. Maxwell distribution. Internal energy of a gas. Ideal gas pressure. Equation of state. Gas laws. Specific heat of an ideal gas.
Thermodynamics: First law of thermodynamics. Isoprocesses, adiabatic and polytropic processes. Real gas. Van der Waals equation. Second law of thermodynamics. Efficiency (coefficient of performance). Carnot cycle. Entropy. Enthalpy. Phase transitions.
Optics: Nature and speed of light. Electromagnetic spectrum. Geometric optics: Laws of reflection and refraction. Refraction through a prism and a plane-parallel plate. Dispersion of light. Plane and spherical mirrors. Lenses. Magnifying glass and microscope.
Wave Optics: Coherent light. Interference, diffraction, and polarization of light.

*Practical teaching*

Problems from the aforementioned fields. Determination of the surface tension constant and the viscosity coefficient of liquids; Verification of Boyle's and Gay-Lussac's laws. Determination of the latent heat of vaporization; Determination of the focal length of converging and diverging lenses; Determination of the wavelength of light using a diffraction grating.

**Literature**

Avramov, M: Fizika-skripta, Visoka tehnička škola strukovnih studija, Novi Sad, 2009

Petrović, V, Avramov, M.: Fizika – zbirka zadataka, Visoka tehnička škola strukovnih studija, Novi Sad, 2021

Petrović, V, Avramov, M.,: Fizika – Praktikum za laboratorijske vežbe, Visoka tehnička škola strukovnih studija, Novi Sad, 2021

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching method**:

Monologic, dialogic and interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | 10 | Oral exam | |
| Interim exam/s | 40 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Technical drawing with descriptive geometry**

**Teacher: Vladimir Blanuša**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

Understanding spatial relationships (spatial visualization) and achieving technical literacy (enabling the reading of technical drawings and the creation of simple technical sketches).

**Learning outcomes**

Students will be equipped to perform tasks related to the creation and reading of technical drawings.

**Course contents**

*Theoretical teaching*

Technical drawing tools. Projections of a point: onto one, two, and three planes. Quadrants and octants. Projections of a line and a segment. Visibility of line projections. Planes. Traces of a plane. A plane defined by intersecting lines. A plane defined by a triangle. Strike lines (principal horizontal lines). First and second strike lines. Intersection of a line and a plane (penetration). Inclination lines. Technical drawing: scale, lines, sheet format, and technical lettering. Principal projections, required projections. Sections of a body: full section, half section, partial section, and stepped section. Dimensioning: dimensioning methods, dimensioning symbols. Sectional views in technical drawing, simplifications, and special projections. Completing characteristic views. Required projections and selecting characteristic views. Dimensioning. Tolerances. Surface qualities. Mechanical technical drawings. Civil engineering technical drawings. Electrical engineering technical drawings. Computers in engineering communications.

*Practical teaching*

Computational exercises that follow the theoretical lectures. Octants. Projection of a point onto projection planes. Projection of a straight line onto projection planes. Intersection of a line and a projection plane. Drawing projections of bodies based on 3D models. Reading simple technical drawings. Execution of graphic assignments.

**Literature**

Blanuša V.: Tehničko crtanje sa nacrtnom geometrijom (elektronski materijal), VTŠ, Novi Sad, 2020

Segedinac T: Tehničko crtanje sa nacrtnom geometrijom, VTŠ, Novi Sad, 2010. Dovniković, L: Tehničko crtanje sa nacrtnom geometrijom, Fakultet tehničkih nauka u Novom Sadu, Novi Sad, 1989

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**

Monologic, dialogic, and interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 20 | | |
| Graphic assignments* | 30 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Fundamentals of computing**

**Teacher: Lazo Manojlović**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

To enable students to learn the fundamental concepts of information technology related to computer components, hardware, software, the concepts of primary memory (RAM) and external storage, information networks, and internet security. Additionally, students should learn to use word processing software such as Word, spreadsheet software such as Excel, raster graphics editing software such as Photoshop, and presentation software such as PowerPoint, or similar applications, in their daily work.

**Learning outcomes**

Proficient use of Word, Excel, Photoshop, PowerPoint, or similar applications in daily life, further education, and future career. Students are equipped to use the Windows operating system and to properly and safely utilize the internet and its services. By understanding the basic functions and services of computers, students will be able to further develop more detailed, specific knowledge depending on their future profession.

**Course contents**

*Theoretical teaching*

Computer development to date and future development directions. Number systems. Binary number system and arithmetic operations. Data encoding in a computer. Code pages. Boolean algebra and its application. Logic gates in a computer.

Computer organization and architecture. Computer hardware components. Processor (CPU). Motherboard.

Primary memory (RAM). Types of external storage. Input devices. Output devices. Video system. The role and importance of the internet. Internet services.

Types of computer software. The role of the operating system. The concept of an information system. Types of computer applications. Safe computer operation.

*Practical teaching*

Basics of using the Windows operating system. Basics of using the Internet. Working with software applications: word processing (Word or similar), spreadsheets (Excel or similar), photo editing (Photoshop or similar), and presentations (PowerPoint or similar).

**Literature**

Ružić Dimitrijević, Lj., Lovreković, Z., Subić, N.: Računari i praktikum, VTŠ, Novi Sad, 2015

Zoranović, T.: Informatika, Poljoprivredni fakultet, Univerzitet u Novom Sadu, Novi Sad, 2021

Jovanović, P.: Računajte na računare (digitalna edicija), Računajte na računare, 2010

Eremić, Ž.: Računari - udžbenik, Visoka tehnička škola strukovnih studija u Zrenjaninu, Zrenjanin, 2021

Frye C.: Microsoft Office Excel 2019:korak po korak, CET, 2019

| **Active teaching classes: 45** | **Theoretical teaching: 15** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**

Monologic, interactive, laboratory.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | 5 | Written exam | 50 |
| Practical work | 45 | Oral exam | |
| Interim exam/s | | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Business communications**

**Teacher: Jovana Kopanja**

**Course status: Elective**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

To equip students for written and oral communication within the organization and with its environment under contemporary business conditions, and to provide them with insights into the relevant social, cultural, sociological, economic, and political factors.

**Learning outcomes**

Based on the mastered material, the student will understand the process, functions, models, forms, and channels of business communications, as well as their strategic importance and role in creating the enterprise's identity, reputation, and value. The student will be able to communicate successfully within and outside the enterprise while understanding an interconnected yet culturally, religiously, and socio-politically diverse world. The student will master basic grammatical rules, know how to select adequate vocabulary, and independently write a business letter and email, respecting the rules of business correspondence.

**Course contents**

*Theoretical teaching*

Language in communication: Defining the terms language and communication. Elements and phases of communication. Language and speech. Language and script. Oral and written speech. Speech culture. Cultivated speech. Attributes of good speech. Orthography: Basic spelling rules. Sound changes: Sound change rules and examples of deviations. Communicative competence: The concept of linguistic culture. Levels of speech culture. Grammatical norm. Use of foreign words. Social and individual language stratification. Speech constants. Criteria for assessing communicative competence. Personal appearance in business communication: Business communication. Verbal and non-verbal communication. Paralinguistic cues. Distance between interlocutors. Pauses in speech. The importance of active listening in communication. Business conversation. Telephone conversation. Elements of business presentation. Forms of personal appearance. The concept of empathy. Public relations: Manipulation in mass communication. Disinformation. Advertising. Propaganda. Defining the concept of public relations and **its** role. Communication procedures in public relations. Public relations tools. Advantages and disadvantages of public relations. Written business communication: Written business communication. Advantages and disadvantages of written business communication. Electronic communication. Visual communication. Culture and language culture: Culture as thinking and process. The relationship between culture and language culture. Creativity and communication - techniques of creative thinking: The concept of creativity. Intelligence and creativity. Negotiation: Motives for negotiations. Approaches to negotiation. Methods of negotiation. Preparation for negotiations. The negotiation process. Conclusion and implementation of agreements. Society, state and nation: Explanation of the concepts of society, state and nation. Man and organization, organizational culture: Formal and informal communication. The concept of bureaucracy. Bureaucratic style. Vertical and horizontal forms of formal communication. Types of organizations. Socio-cultural and psychological barriers to communication and their overcoming. Communication between cultures and communication strategies. Communication and cultural context. Cultural differences. Business communication contexts: Idea formation. Oral presentation. Business meetings and negotiation strategy. Types of power in communication. Business communication contexts: Marketing communications. Stakeholder philosophy. Problem-solving and decision-making**.**

*Practical teaching*

In practical classes, students will master the principles of good written and oral communication through practical examples, written and listening exercises. Using examples and exercises, students will become familiar with grammatical rules at the levels of phonology, morphology, syntax, and vocabulary. Students will write a business letter and email and prepare for a business conversation and meeting.

**Literature**

Šipka, M.: Pravopisni rečnik srpskog jezika, Novi Sad, Prometej, 2010
Čokorolo R.: Poslovne komunikacije, Novi Sad, Alfagraf, 2008
Pešikan, M., Pižurica, M., Jerković, J. : Pravopis srpskog jezika, Novi Sad, Matica Srpska, 2017
Pavić, Ž.: Etika i poslovne komunikacije, Beograd, Univerzitet Singidunum, (elektronska verzija), 2011
Šulc fon Tun, F.: Kako razgovaramo? Problemi i rešenja, Beograd, Laguna, 2020
Šulc fon Tun, F.: Kako razgovaramo 2: Stilovi, vrednosti i razvoj ličnosti, Beograd, Laguna, 2020

| **Active teaching classes: 60** | **Theoretical teaching: 45** | **Practical teaching: 15** |
|---|---|---|

**Teaching methods**: Oral presentation, conversation, discussion and demonstration.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Business law**

**Teacher: Ivan Bulatović**

**Course status: Elective**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

The aim of this course is to familiarize students with the legal framework of business and managerial decision-making. Students acquire foundational knowledge of general legal concepts, core institutes of various branches of law, business entities, and their business relationships. In addition to theoretical fundamentals, this course provides systematized practical insights necessary for understanding and resolving specific business issues. Furthermore, students will develop practical skills in drafting contracts, formulating offers, and executing acceptances. They will explore the differences between Serbia's Law on Personal Data Protection and international privacy regulations. Finally, the course covers the basics of drafting copyright agreements, as well as preparing patent applications and structuring invention descriptions.

**Learning outcomes**

By mastering the course content, students acquire the following specific competencies: thorough knowledge and understanding of the principles of law, and the ability to solve specific problems by connecting basic knowledge from different branches of law, such as property law**,** law of obligations, and intellectual property law. Students acquire and improve their ability to apply innovations in the profession by following current regulations and legal commentaries in professional literature. In addition, they develop skills for independent work and the practical application of knowledge (drafting contracts, making offers, and accepting offers). Students will also familiarize themselves with drafting *service agreements,* preparing patent applications, and structuring invention descriptions within those applications.

**Course contents**

*Theoretical teaching*

General concepts in law: State, legal order and legal system, legal norm, concept and attributes of a legal entity. Concept and types of property rights: Concept of property rights, things, state property, ownership rights**.** Law of obligations: Contracts, types of contracts, formation of a contract, offer, acceptance of an offer, subject matter of a contract, legal instruments for securing contract performance and liability for damages. Right to privacy and data processing: Privacy – concept, Law on Personal Data Protection in Serbia and global privacy protection laws. Jurisdictional challenges. Intellectual property: Forms of intellectual property. Copyright and related rights: Copyrighted work as an object of protection. Scope of protection of copyrighted work. Classification of copyrighted works. Subject of copyright - author and copyright holder, as well as co-authors and joint works. Origin and content of subjective copyright: Moral rights. Economic rights. Limitations of subjective copyright and its duration. Database producer's right: Database as an object of protection. Subject matter and content of protection. Duration of rights. Rights of the first publisher of an unprotected work: Subject matter, scope and content of protection. Duration of rights. Industrial property rights: Patent law. Invention as an object of protection. Patentability criteria. Invention right - right to patent protection: Conflict between two independent inventors over the right to a patent. Lawsuit for determining inventor status. Lawsuit for challenging the right to protection. Specifics of the patent granting procedure: Patent application, sufficient description of the invention in the application, unity of invention – divisional application, supplementary application, right of priority, publication of the invention and substantive examination. Origin, duration and termination of the patent: Termination with *ex nunc* effect.

*Practical teaching*

During practical classes, students will review the covered material and analyze real-world case studies. They will engage in drafting various types of contracts, as well as making and accepting offers. Through case analysis, students will examine and identify the differences between Serbia's Law on Personal Data Protection and international privacy regulations. Furthermore, they will practice drafting copyright agreements, evaluating patentability criteria, preparing patent applications, and structuring invention descriptions within those applications.

**Literature**

Ljubojević, G., Milošević, I., Poslovno pravo, Visoka poslovna škola strukovnih studija, Novi Sad, 2020
Vernart, B., Međunarodno pravo i poslovanje, Visoka poslovna škola strukovnih studija, Novi Sad, 2022
Marković, S., Popović, D., Pravo intelektualne svojine, Pravni fakultet univerziteta u Beogradu, Beograd, 2022
Spirović-Jovanović, L., Dabić, L., Poslovno pravo, Beograd, Ekonomski fakultet Beograd, 2015
Šogorov, S., Radoman, M., Poslovno pravo, Univerzitet Singidunum, Beograd, 2007

| **Active teaching classes: 60** | **Theoretical teaching: 45** | **Practical teaching: 15** |
|---|---|---|

**Teaching methods**: Oral presentation, conversation, discussion and demonstration.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | 10 | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 40 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Engineering communications**

**Teacher: Biljana Gemović**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

Introducing students to software used for drawing and shaping mechanical, structural and design segments.

**Learning outcomes**

Students will be equipped to independently draw workshop and assembly drawings using computer software and technical drawing principles, and to generate complete product technical documentation.

**Course contents**

*Theoretical teaching*

Workshop drawings: requirements, elements of a workshop drawing, and production methods. Assembly drawings: requirements, elements of assembly drawings, and production methods. Installation (erection) drawings: oblique projection drafting using the indirect projection method, elements of installation drawings, and production methods. Mechanical engineering projects: components and production methods. Electrical power engineering projects: components, production methods, and report writing. Technical drawings in mechanical, electrical, and civil engineering.

Basic concepts and structure of CAD. Engineering design: phases, types of structures. Function structure. Conceptual design development. Dimensioning of parts: functional dimensioning, dimensioning based on stress and other component states. Optimization of dimensions using iterative procedures. Design for manufacturing (DFM): cast, forged, welded, and machined parts. Modern CAD software: AutoCAD, PRO/Engineer, and others. 3D solid modelling and 2D drafting.

Fundamentals of design science: the engineering design process, structure, and environment. Elements of systems theory. Elements of information and decision theory. New product development. Generation of product technical documentation.

*Practical teaching*

Introduction to the AutoCAD user interface and software. 2D drafting of mechanical parts. Creation of workshop and assembly drawings. Dimensioning. Adding text to drawings. Plotting and printing. Working in AutoCAD 3D.

**Literature**

Kovačević S., Gemović B.: CAD, VTŠ, Novi Sad, 2006

Gemović B.: Kompjuterska grafika, VTSNS, Novi Sad. 2020

Dovniković, L.: Tehničko crtanje sa nacrtnom geometrijom, Fakultet tehničkih nauka u Novom Sadu, Novi Sad, 1989

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods** Interactive, demonstrative and laboratory.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Metal forming processes**

**Teacher: Nenad Janjić, Aleksandar Čabrilo**

**Course status: Compulsory**

**Number of ECTS: 5**

**Prerequisite course: None**

**Course objective**

To enable students to independently design and implement manufacturing technological processes for forging production, metal forming processes, as well as welding, soldering, and metallization processes.

**Learning outcomes**

Students will acquire knowledge in designing and implementing manufacturing technological processes for forging production, metal forming processes, as well as welding, soldering, and metallization processes.

**Course contents**

*Theoretical teaching*

***Casting***. Modern casting processes. Casting materials. Foundry processes. Casting in sand-bentonite molds: manual and machine molding.
Basic principles of designing the technological process for manufacturing castings in sand-bentonite molds. Shell mold casting. Investment casting.
Permanent mold casting. Die casting. Centrifugal casting. Shakeout, cleaning, and finishing of castings.
***Forming***. Fundamentals of plastic deformation theory. Forging: types of forging, design of forgings. Technological process of hot forging. Forging machines. Forging dies and tools.
Cold forging. Extrusion of machine components. Rolling: rolling of sheets, strips, and profiles, tube rolling, ball rolling, thread rolling, gear rolling, ring rolling.
Blanking and piercing: process characteristics, materials, devices and tools for piercing and blanking.
Designing the workpiece and the technological process.
Deep drawing: process characteristics, materials, devices and tools for deep drawing. Application area. Bending: process characteristics, materials, devices and tools for bending. Bending of profiles, wire and tubes.
Physical fundamentals of ***welding, soldering and metallization***. Process characteristics and application areas. Welding. Welding consumables. Welding arc.
Shielded Metal Arc Welding (SMAW). Submerged Arc Welding (SAW). Gas-shielded arc welding in active and inert gas atmospheres – MAG, MIG, and TIG welding processes.
Resistance welding. Gas welding. Soldering and metallization.
Passing the interim exams in welding, soldering and metallization procedures.

*Practical teaching*

Exercises aligned with the theoretical lectures will be conducted. Laboratory exercises: Students practically apply the acquired knowledge using available laboratory equipment (welding via various processes: SMAW, Gas, and TIG welding). A portion of the laboratory exercises takes place at the BMTS Technology company, focusing on the optimization of the manufacturing technological process using metal forming tools, as well as the optimization of different casting processes.

**Literature**

Joković, Ž: Tehnologija proizvodnje odlivaka, VTŠ Novi Sad, Novi Sad, 2009
Joković, Ž: Obrada metala plastičnom deformacijom - skripta, Novi Sad, 1998
Joković, Ž: Zavarivanje - skripta, Novi Sad, 1999
Musafija, B: Obrada metala plastičnom deformacijom, Svjetlost, Sarajevo, 1972
Popović, O: Postupci zavarivanja, MF Beograd, 2016
Bogner, M.: Zavarivanje, Eta Beograd, 2007

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods:** Interactive, demonstrative and laboratory.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | |
| Practical work | | Oral exam | 50 |
| Interim exam/s | 30 | | |
| Seminar paper/s | 20 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Computer-aided design**

**Teacher: Vladimir Blanuša**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

The course aims to provide students with the necessary knowledge in the field of computer-aided design (CAD) through the application of modern software tools.

**Learning outcomes**

Upon completing the course, students will know how to apply modern software systems in the design process.

**Course contents**

*Theoretical teaching*

Fundamentals of design and design process automation. Design as an engineering activity. Fundamentals of product design (development) theories and methodologies. The need for design process automation. Potential for design automation. Fields and phases of design. Global overview of design process automation capabilities. Types of tasks in a designer's workflow. Automation capabilities in graphically oriented phases. Conceptual calculations, engineering calculations, and verifications. Assembly design. Part design. Design in the field of manufacturing processes. Importance and objectives of product design. Basic concepts in design process automation. Computer-aided modelling. Software systems for product design. Computer-aided calculation and analysis. Finite Element Method (FEM). Automated calculation systems based on the Finite Element Method.
Working in the SolidWORKS 2022 software system.

*Practical teaching*

Working with modern software systems. Working in the SolidWORKS 2022 software system. Creating sketches. Modelling commands. Creating 3D models. Automated technical documentation generation. Assembly creation. Computer-aided engineering using modern software systems.

**Literature**

Zeljković M., Tabaković, S., Živković A., Živanović, S., Mlađenović, C., Knežev, M.: Osnove CAD/CAE/CAM tehnologija, Fakultet tehničkih nauka, Novi Sad, 2018

Blanuša, V.: Računarom podržano projektovanje (elektronski materijal), VTŠSS, Novi Sad, 2022

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**: Interactive, demonstrative and laboratory.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Mechanics**

**Teacher: Vladimir Blanuša**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

Mastering the fundamentals of an engineering mindset and solving problems in the fields of statics, kinematics, and dynamics.

**Learning outcomes**

Students have acquired the ability to solve problems in the fields of statics, kinematics, and dynamics.

**Course contents**

*Theoretical teaching*

Definition and basic concepts of statics. Axioms of statics. Two fundamental problems of statics. System of collinear forces. System of concurrent forces. Three-force theorem. Moment of a force about a point. Moment of a force about an axis. Virial of a force. Varignon's theorem for a system of concurrent forces. Couples. General theorems of statics. Resultant force and resultant moment of a force system. Parallel forces in a plane. Arbitrary coplanar force systems. Sliding friction. Rolling resistance. Spatial force systems. Static invariants. Wrench. Equation of the central axis. Equilibrium of spatial force systems. Catenary.

Plane curves. Kinematics of a particle. Trajectory, velocity, and acceleration of a particle. Velocity and acceleration hodographs of a particle. Areal velocity and areal acceleration. Rotation of a rigid body about a fixed axis. Plane motion of a rigid body. Velocity and acceleration of points in a rigid body. Velocity and acceleration distribution equations of a rigid body. Instantaneous center of zero velocity and instantaneous center of acceleration.

Dynamics of a particle. Two fundamental problems of particle dynamics. Equations of motion for free and constrained particles. Angular momentum of a particle. Work. Power. Potential energy of a particle. Kinetic energy of a particle. Dynamics of plane motion of a rigid body. Equations of motion for a rigid body in a plane.

*Practical teaching*

Solving numerical problems covering the following topics: Vectors, concurrent force systems, and the moment of a force about a point. Coplanar (plane) statics and spatial (3D) statics. Plane curves. Kinematics of a particle and plane motion kinematics of a body. Dynamics of a particle and plane motion dynamics of a body.

**Literature**

Blanuša, V., Milisavljević, B.: Mehanika 1, Visoka tehnička škola strukovnih studija, Novi Sad, 2021

Targ, S.M: Kratki kurs teorijske mehanike, Naučna knjiga, Beograd, 1968

Rašković, D.: Statika, Naučna knjiga, Beograd, 1978

| **Active teaching classes: 75** | **Theoretical teaching: 30** | **Practical teaching: 45** |
|---|---|---|

**Teaching methods:** Monologic, dialogic, interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Strength of materials**

**Teacher: Ranko Antunović**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

To introduce students to the interrelationships among loads, stresses, deformations, the shape and dimensions of bodies, and material properties.

**Learning outcomes**

The student understands the interrelationships among loads, stresses, deformations, the shape and dimensions of bodies, and material properties.

**Course contents**

*Theoretical teaching*

***Introduction to strength of materials***. Objective of strength of materials. Fundamental hypotheses in strength of materials. Classification of bodies by shape. Types of forces. ***Geometric properties of plane sections.*** First moments of area. Moments of inertia of plane sections. Parallel axis theorem (Steiner's theorem). Moments of inertia under coordinate system rotation. First invariant of inertia. Principal centroidal moments of inertia. Radius of gyration. Ellipse of inertia***. Basic types of loading. Stress and strain***. Types of stress. Concept of stress. Concept of strain. ***Buckling***. Critical load. Critical stress. Sizing for buckling according to Euler's and Tetmeier's formulas. ***Axial loading (tension or compression).*** Longitudinal and lateral strain. Relationship between longitudinal and lateral strain (Poisson's ratio). Thermal deformation of a bar. Normal stress. Relationship between stress and strain. Hooke's law. Deformation of a bar subjected to axial loading. ***Torsion***. Torsional shear stress. Torsional deformation. Sizing under torsion. Torsion of beams with circular and hollow circular cross-sections. ***Biaxial stress state***. Plane stress. Shear. ***Bending.*** Pure bending by couples. First fundamental equation of bending. Bending of beams under vertical loads. Normal and shear stress. Section moduli of plane sections. Sizing of a beam subjected to bending. Beams of constant bending stress (ideal beam shape). Unsymmetrical bending. Deflection curves. Differential equation of the deflection curve. Analytical method for determining the deflection curve. Deflection-deformation. Bending of statically indeterminate beams. Degree of static indeterminacy. Single-span and two-span beams. ***Combined loading***. Bending and compression. Eccentric compression. Core of the section. ***Strain energy***. Strain energy under axial loading.

*Practical teaching*

Moments of inertia of plane sections. Buckling of a bar. Bending of beams. Preparation and defense of two graphic projects.

**Literature**

Gavanski. Lj., Gavanski, D.: Zbirka rešenih zadataka iz otpornosti materijala, Visoka tehnička škola strukovnih studija, Novi Sad, 2013

Radić, N., Jeremić, D.: Otpornost materijala 1, Univerzitet u Istočnom Sarajevu, Mašinski fakultet, Istočno Sarajevo, 2018 (elektronsko izdanje)

Žiga, A., Kačmarčik, J.: Otpornost materijala 1, Univerzitet u Zenici, Mašinski fakultet, Zeica, 2020 (elektronsko izdanje)

Golubović-Bugarski, V.: Tehnička mehanika 1, skripta - izvod sa predavanja, Univerzitet u Banjoj Luci, Tehnološki fakultet, Banja Luka, 2012 (elektronsko izdanje)

| **Active teaching classes: 60** | **Theoretical teaching: 45** | **Practical teaching: 15** |
|---|---|---|

**Teaching methods**

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | **50** |
| Practical work | | Oral exam | |
| Interim exam/s | **40 (20+20)** | | |
| Seminar paper/s | **10 (2x5)** | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Elements of automation**

**Teacher: Ranko Antunović**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

Acquiring knowledge on the possibilities and effects of implementing small-scale automation in material production. Developing systemic knowledge on the operation and performance characteristics of various small-scale automation elements, as well as the design principles of automated systems in material production.

**Learning outcomes**

Knowledge and understanding of different types of automation elements, in order to select the most suitable solutions for specific engineering problems. Ability to select components for system design of pneumatic and hydraulic systems. Selection and practical connection of pneumatic components to implement a system that fulfills the given target function. Gaining self-confidence in solving practical engineering problems and tasks imposed by production, both in teams and individually.

**Course contents**

*Theoretical teaching*

Introduction: Automation. Automatic control system (ACS). Automatic management system. Process control.
Automatic control system: graphical symbols, structural block diagram of ACS, examples of automatic control systems, operating modes of ACS, characteristics of ACS elements, classification of ACS, analysis and synthesis of ACS, description of ACS behavior, mathematical description of dynamic behavior of ACS, definition of mathematical models.
Measuring transducers: basic concepts and classifications, characteristics of measuring transducers (sensors), transducers (voltage to normalized current signal, frequency, electrical power, displacement, temperature, rotational speed, pressure, flow). Error signal detectors.
Controllers: basic concepts and classifications, amplifiers, P-controller, I-controller, D-controller, PI-controller, PID-controller. Commissioning of electric motor drive control systems.
Actuators: electrical actuators, DC and AC motors, synchronous and asynchronous motors, stepper motors, mechanical motion and power transmission systems, linear electric motors. Pneumatic actuators (cylinders, motors, valves). Hydraulic actuators (cylinders, pumps and motors, valves).
Computer-based process control: general characteristics of digital computers, basic procedures in developing process control systems, types of computer-based process control, NC (Numerical Control) machines, CNC machines. Systems: PLC (Programmable Logic Controller), AC (Adaptive Control), DNC (Direct Numerical Control), Industrial robots. Integrating computers into a control system. Management organization of complex systems. Process control using SCADA systems. Industrial process control devices. Protection elements in switchgear and distribution plants. Signaling devices.

*Practical teaching*

Scope of application of the ISO 1219 standard (specifically SRPS N.L1.003-006). Presentation of didactic equipment, and methods of learning and working with didactic equipment. Methods of positioning and connecting structural elements during laboratory exercises. Actuators/working structural elements, actuator speed, and speed regulation. Control structural elements, minimal form. Processor structural elements, setup, and application.

**Literature**

Vuković, V.: Uvod u hidropneumatsku tehniku, FTN, Novi Sad, 2005
Šešlija, D.: Pneumatski sistemi, FTN, Novi Sad, 2005
Savić, V.: Osnovi uljne hidraulike, Ikos, Novi Sad, 2002
Ilić, B.: Elementi automatizacije (elektronski materijal), VTŠ, Novi Sad, 2019

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods:** Interactive, demonstrative.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | 25 | Oral exam | |
| Interim exam/s | 25 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Quality management**

**Teacher: Biljana Gemović**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

Introducing students to measurement methods and devices, as well as the quality management system within enterprises.

**Learning outcomes**

Acquired knowledge in the field of study of Quality Management.

**Course contents**

*Theoretical teaching*

Basic concepts of quality systems: Concept of quality; Quality terminology; Quality loop; Historical development of quality; Modern general product quality model; Enterprise, market, and product: Impact of basic market factors; Product life cycle and enterprise cycle; Product quality and quality costs; Juran's quality trilogy; Customer-enterprise relationship; Corporate identity; PAEI system; Adizes methodology; Efficiency and effectiveness; Venn diagram; Quality and ISO 9000; Quality terminology according to ISO 9000; Quality assurance; Quality policy; Quality and competitive market; Quality indicators and quality measurement; Inspection and testing; Costs of poor quality; Corrective actions and priorities; Deming cycle (PDCA), Quality measurement histogram, Methods and techniques for quality improvement, Basic concepts and definitions in quality systems. ISO 9001, OHSAS standards, ISO 14000, ISO 22000, HACCP system, Quality systems in the field of information technologies and their application.

*Practical teaching*

Measurement and control; Pareto chart; Cause-and-effect diagram (Ishikawa); Integration of control techniques with other departments; Quality improvement process and application; Fundamentals of measurement: Origin, development, and units of measurement. Measurement errors. Single-value gauges: Gauge blocks. Limit gauges. Graduated measuring instruments: Rulers. Vernier calipers. Micrometers. Dial indicators (Comparators). Measuring machines: Abbe's comparator. Universal measuring machine. Coordinate measuring machine (CMM). Measurement and control of angles: Comparative, trigonometric, and goniometric methods. Measurement and control of form: Direct and indirect methods. Thread measurement and control: Limit gauges. Thread micrometers. Toolmaker's microscope. Gear measurement and inspection: Complex and individual methods. Surface quality testing: Flatness and roughness. Automation of length control: Passive and active devices. Fundamentals of Statistical Quality Control (SQC) methods: Control charts.

**Literature**

Gemović, B: Upravljanje kvalitetom i sistemi kvaliteta- udžbenik, VTŠNS, Novi Sad, 2013. Kovačević, S: Merenje i kontrola, Praktikum, VTŠ, Novi Sad, 2005

Kovačević, S: Upravljanje kvalitetom, VTŠ, Novi Sad, 2010

Kostić M.: Metode i tehnike za poboljšanje kvaliteta – Statističke metode i tehnike, Beograd, Visoka Beogradska politehnika, 2004

Vulanović V., Stanivuković D., Kamberović B. i dr, : Sistem kvaliteta ISO 9001:2000, FTN, Novi Sad 2003

Papić Lj. Milunović S.: Menadžment kvaliteta u uslovima neodređenosti, DQM, Prijedor 2005

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods:** Monologic, dialogic, interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 35 | | |
| Seminar paper/s | 15 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Fundamentals of energy systems**

**Teacher: Miodrag Kovačević**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

Introduction to approaching and solving energy-related problems.

**Learning outcomes**

Students will acquire knowledge that will enable them to solve energy-related problems.

**Course contents**

*Theoretical teaching*

**Hydromechanics (Fluid Mechanics).** Fluid. Basic physical properties of fluids. Continuity equation for compressible and incompressible fluids. Fundamental equations of hydrostatics. Flow through pipes and channels. Darcy-Weisbach equation. Similarity theory. Navier-Stokes equations. Similarity theory and dimensional analysis in hydrodynamics. Laminar and turbulent flow.

**Thermodynamics.** Basic concepts and definitions. State parameters. Ideal gas. Fundamental laws of an ideal gas. Ideal gas equation of state. Basic thermodynamic processes. Polytropic processes. Second law of thermodynamics. Water vapor. Changes of state of water vapor. Humid air. Processes involving humid air. Heat pumps.

**Heat Transfer.** Heat conduction. Steady-state heat conduction. Heat conduction through a flat finned surface. Transient heat conduction. Plate cooling. Plate heating. Heat convection. Newton's law of cooling (heat convection). Similarity theory and dimensional analysis in heat transfer. Dimensionless equations for heat convection. Heat transmission through a flat partition. Heat transmission through a cylindrical partition. Critical insulation thickness of a pipe.

**Boilers:** Operating principle of a steam boiler. Fuels for steam boilers. Heating value of fuel. Composition and quantity of combustion products. Enthalpy of air and combustion products. Thermal balance of a steam boiler. Water vapour. Determination of the efficiency of a steam boiler. Steam boiler furnaces. Steam superheaters. Economizers. Regenerative water heaters. Classification of boilers. Application of liquid and gaseous fuel boilers.

**Compressors:** Working processes in compressors. Reciprocating compressors. Dynamic compressors. Compressor stations.

*Practical teaching*

Solving numerical problems aligned with the topics covered in the theoretical classes.

**Literature**

Čantrak C.: Mehanika fluida, Mašinski fakultet, Beograd, 2005

Miljković B.: Zbirka rešenih zadataka iz termodinamike, FTN-Novi Sad, 2017. Lambić M.: Termodinamika, Zavod za udžbenike, Beograd, 2005

Milisavljević B.: Hidridinamika, teorija sličnosti-dimenzionala analiza, VTŠ, Novi SAD, 2013

Milovanović Z.: Termoenergetska postrojenja (elektronski materijal), Mašinski fakultet, Banja Luka, 2011

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**

Monologic, dialogic, interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | |
| Practical work | | Oral exam | 50 |
| Interim exam/s | 30 | | |
| Seminar paper/s | 20 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Engineering materials**

**Teacher: Vesna Petrović, Ranko Antunović**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

Introducing students to types of engineering materials, as well as material structures, chemical bonds, material defects, and basic processing principles. Students are introduced to the mechanical and thermal properties of specific materials to enable them to select the most suitable material based on the intended purpose of the product.

**Learning outcomes**

Students possess knowledge of the types and characteristics of basic engineering materials: metals, ceramics, polymers, and composites. They are capable of determining hardness, certain mechanical parameters, flammability classes, and categorizing polymers. Students know how to determine the quantitative ratio of structural constituents and phases in metastable iron-iron carbide phase diagrams. They understand that modern science continuously works on improving specific material properties and developing "new" materials.

**Course contents**

*Theoretical teaching*

***Introduction to materials***: development of materials. Classification of materials. Classification of material characteristics.
***States of matter in metals***: Atomic structure of materials. Characteristics of the states of matter. Phase diagrams, phase rule. Gibbs' phase rule.
***Solid state of metals***: Crystal lattices and basic characteristics. Types of bonds in the lattice. Lattice defects.
***Crystal structure of materials***: Amorphous and crystalline structures. Elements of the crystal lattice. Crystal systems and unit cell types. Crystal structure defects. Crystallization: Mechanism and laws of crystallization.
***Material behavior under external forces***: Static testing. Hardness testing. Impact toughness. Dynamic testing. Tensile testing at elevated temperatures.
***Iron alloys and phase transformations in the solid state***: Pure iron. Carbon in iron alloys. Metastable iron-iron carbide phase diagram.
***Classification of steels and casting alloys***: Designation of steels. Influence of alloying elements in steels. Classification of steels by application. Cast iron. Cast steel. Structural cast steel.
***Ceramics***: Structure, properties, and application. Nanomaterials and nanoceramics. ***Glasses***: Amorphous structure of glass. Types and characteristics of glasses. ***Polymeric materials***: Types and classification of polymeric materials and their application in mechanical engineering. ***Composites***. ***Engineered wood and paper***: Characteristics, composition, and properties. Wood-based panels. Paper as an engineering material.
***Testing material behavior at elevated temperatures***: determination of flammability and material flammability groups.
***Overview of new materials***.

*Practical teaching*

Computational problems from specific topics. Crystal growth. Determination of material flammability based on the hazard level in a crucible furnace and determination of the flammability group. Thermal characteristics of polymeric materials. Hardness testing of materials. Tensile testing of materials.

**Literature**

Jovanović, M., Adamović, D., Lazić, V., Ratković, N: Mašinski materijali, Univerzitet u Kragujevcu, Mašinski fakultet Kragujevac, Kragujevac, 2003

Prokić Cvetković, R., Popović, O: Mašinski materijali 1, Univerzitet u Beogradu, Mašinski fakultet, Beograd, 2016

Petrović, V., Božović, T., Čabrilo, A.: Materijali-praktikum za laboratorijske vežbe, VTŠSS Novi Sad, 2022

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **45** |
|---|---|---|

**Teaching methods**: Monologic, dialogic, interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | 10 | Oral exam | |
| Interim exam/s | 30 | | |
| Seminar paper/s | 10 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Fundamentals of electrical engineering 1**

**Teacher: Branislav Santrač**

**Course status: Elective**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

To introduce students to the fundamental concepts and laws of electrostatics, direct current (DC) circuits, electromagnetism, and alternating current (AC) circuits.

**Learning outcomes**

Students will understand the fundamental concepts and laws of electrostatics, direct current (DC) circuits, electromagnetism, and alternating current (AC) circuits. Furthermore, they will be capable of solving theoretical and practical problems within these subject areas.

**Course contents**

*Theoretical teaching*

***Electrostatics:*** Concepts of static electricity, electrostatic field, behavior of materials in an electrostatic field, capacitors.

***Direct Current (DC):*** Concept of electric current, electric circuit and its elements, resistance and conductivity of materials, voltage, current intensity and their magnitudes, Ohm's law, open-circuit, operating mode, and short-circuit, complex electrical circuits, Kirchhoff's laws, power and work of electric current, Joule's law, effects of electric current: thermal effect, heating of conductors by electric current, thermoelectricity.

***Electromagnetism:*** Magnetic field of a permanent magnet and electric current, current-carrying conductor in a magnetic field, mutual interaction of current-carrying conductors, behavior of materials in a magnetic field, ferromagnetic materials, magnetic hysteresis, magnetic materials, magnetic circuit, electromagnetic induction, self-induction, mutual induction, eddy currents.

***Alternating Current (AC):*** Vector representation of alternating quantities, phasor and vector diagrams, impedance in alternating current circuits, alternating current power, power factor, three-phase alternating current systems, power of a three-phase system.

*Practical teaching*

Solving numerical problems from all covered subject areas, working through problems on the blackboard, and group problem-solving exercises.

**Literature**


B. Santrač, S. Skoko: Elektrotehnika, VTŠ, Novi Sad, 2014

B. Popović: Osnovi elektrotehnike 2, Građevinska knjiga, Beograd

N. Pekarić-Nađ, V. Bajović: Zbirka rešenih ispitnih zadataka iz osnova elektrotehnike, Građevinska knjiga, Beograd, 1998

A. Torbica: Osnovi elektrotehnike, VTŠ, Novi Sad, 2003

A. Torbica: Elektroenergetika, VTŠ, Novi Sad, 2002

Grupa autora: Bezbednost i zdravlje na radu - knjiga 3, Elektroenergetika, VTŠ Novi Sad, 2011


| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**

Monologic, dialogic, interactive, demonstrative, practical, as well as group and independent student work on solving problems.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Combustion processes**

**Teacher: Saša B. Spaić**

**Course status: Elective**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

The objective of the course is for students to comprehend and master the types, relevant parameters, laws, and outcomes of combustion and thermal decomposition processes, enabling them to identify and resolve practical problems related to these processes. The course provides the fundamental knowledge necessary for further advanced study in all aspects of fire science.

**Learning outcomes**

Students will understand the fundamental concepts related to combustion, fire, and material flammability. They will be capable of writing combustion equations for organic combustible materials in oxygen and air, and they will understand the combustion characteristics of gaseous, solid, and liquid fuels. Regarding fire dynamics, students will master heat transfer mechanisms, combustion products, smoke and heat as hazards, gas movement during fires, and fire suppression chemistry. Furthermore, they will perform calculations related to gas mixtures, fuel combustion processes, and heat transfer that can act as fire ignition sources.

**Course contents**

*Theoretical teaching (Lectures)*

***Introductory considerations***. Combustibility of materials. Combustion. Fire. Flammability. Fire triangle and fire tetrahedron. Fire stages. Backdraft. Flashover. ***Combustion of gases***. Flame classification. Forced and spontaneous ignition of gas mixtures. Lower and upper flammability (explosive) limits. Explosion. Deflagration. Detonation. Chemical mechanism of gas combustion. Examples of hazardous gases. Flammability interval. Influence of temperature, pressure, and the presence of inert gases on the flammability interval. Stoichiometric mixture. Ignition temperature. Activation energy. Autoignition temperature. Cause of ignition. Ignition sources. Ignition energy. Heat of combustion. Heat and pressure of explosion. ***Combustion of liquids***. Mechanism of liquid combustion. Flash point of liquids. Fire point of liquids. Linear and mass burning rate of liquids. Examples of combustion: pure liquid, mixture of miscible flammable liquids, mixture of a flammable liquid miscible with water, flammable liquid lighter than water and immiscible with it (boilover). BLEVE (Boiling Liquid Expanding Vapor Explosion). Flame spread rate across liquid surfaces. Combustion of liquid droplets. Autoignition of liquids. ***Combustion of solids***. *Combustion mechanisms of solids.* Pyrolysis. Flaming combustion. Ignition and autoignition temperature. Smoldering. Char formation and melting. Rate of combustion and flame spread. Cone calorimeter. Combustible dusts. Self-heating and autoignition. Flammable solid materials. Flame retardants. Oxygen consumption calorimetry. Combustion of metals. Exothermic materials. ***Concluding remarks***. Heat transfer mechanisms. Hazards due to heat transfer. Smoke aerosols. Smoke and heat as hazards. Filling of a fire-affected space with smoke. Chemistry of fire suppression.

*Practical teaching (Laboratory exercises)*

Stoichiometric equations of combustion reactions in oxygen and air. Calculation of gas mixture parameters using the ideal gas law equation; calculation of volumetric and mass composition of gas mixtures. Assessment of gas mixture explosiveness. Calculation of the heating value of combustible materials (lower and upper limits). Calculation of the required amount of oxygen and air for combustion, combustion products, and the volumetric composition of combustion products. Calculation of the quantity of heat, heat flow rate, and temperature regimes.

**Literature**

Spaić, S.: Procesi sagorevanja, materijal u elektronskoj formi, dostupan studentima, Novi Sad, 2018
Gann, R.G., Friedman, R.: Principles of Fire Behavior and Combustion, 4th Edition, NFPE (Quincy), Jones&Bartlett Learning (Burlington), 2015
Drysdale, D.: An introduction to fire dynamics, 3rd Edition, John Wiley & Sons Ltd (Chichester), 2011

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**: Monologic, dialogic, interactive, demonstrative.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | 10 | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 40 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: English**

**Teacher: Branka Petrović**

**Course status: Compulsory**

**Number of ECTS: 3**

**Prerequisite course: None**

**Course objective**

Mastering the basic structures and functions of the English language through everyday life situations, while developing speaking, reading, writing, and listening comprehension skills, as well as gaining familiarity with the culture and lifestyle of English-speaking countries.

**Learning outcomes**

Communication at an elementary level of English language proficiency (CEFR level A2).

**Course contents**

*Theoretical teaching*

Phonetic system and orthography: introduction to the sound system of the English language; the alphabet; spelling; phonetic transcription symbols.

Language functions: asking for and giving personal information; filling out forms; greetings; introducing oneself and others; expressing possession, desires, likes/dislikes, and opinions; orientation in space; telling the time; giving directions; inviting and accepting or declining invitations; telephone conversations; ordering in a restaurant; shopping; describing objects and people; conversations about family, habits, daily activities, the past, and the future.

Grammatical structures: personal and demonstrative pronouns; articles; nouns (regular and irregular plural, word formation, and Saxon genitive); possessive and indefinite adjectives; cardinal and ordinal numbers; quantifiers; prepositions; comparison of short adjectives; existential there; adverbs of frequency and definite time; modal verbs can, may, and must; the imperative; Present Simple, Present Continuous, Past Simple (regular and irregular verbs), and Future Simple tenses, and the going to construction.

Vocabulary: words and expressions necessary for communication at an elementary level of English proficiency.

*Practical teaching*

Although separate practical classes are not explicitly scheduled, due to the nature of the course, to a certain extent – depending on the specific teaching units – lectures include activities that involve the practical oral and written application of the English language by the students.

**Literature**

Kovačević, J: Engleski jezik, drugi strani jezik – prva godina učenja, za gimnazije, Zavod za udžbenike i nastavna sredstva, Beograd, 2006

Nastavni materijal predmetnog nastavnika, 2023

Dimitrijević, N., Radovanović, K: Your first English tests, zbirka testova za engleski jezik, Zavod za udžbenike i nastavna sredstva, Beograd, 2007

| **Active teaching classes: 30** | **Theoretical teaching: 30** | **Practical teaching:** |
|---|---|---|

**Teaching methods**

Combined method (monologue, dialogue, demonstration, illustration, and text-based method along with appropriate organizational forms: frontal, individual, group, pair, and team/interactive work).

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Fundamentals of maintenance**

**Teacher: Ranko Antunović, Branko Savić**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

To introduce students to technical system maintenance procedures and technical diagnostics with the aim of ensuring equipment safety and preventing failures in the technological process.

**Learning outcomes**

Students will acquire core knowledge of technical system maintenance, operational procedures, and technical diagnostics.

**Course contents**

*Theoretical teaching*

***Fundamentals of technical systems maintenance***. Technical systems. Maintenance objectives. Maintenance as a production function. Integrated systems approach to maintenance. Maintenance concept, organization, and technology. ***Working capacity and failures of technical systems***. ***System effectiveness and effectiveness indicators***. System effectiveness concepts. System effectiveness indicators. ***Maintenance of technical systems***. Corrective, preventive, and condition-based maintenance. Total Productive Maintenance (TPM). Reliability-Centered Maintenance (RCM). Risk-Based Maintenance (RBM). Performance-based maintenance. Run-to-failure maintenance. Predictive maintenance. Proactive maintenance. ***Technical diagnostics***. Objectives of diagnostic inspections of technical systems. Basic diagnostic methods. Subjective diagnostic methods. Objective diagnostic methods (Operating parameter monitoring procedures; Basic monitoring procedures for wear and combustion products; Root causes of vibrations in technical systems; Non-Destructive Testing (NDT) procedures). ***Objective and structure of a maintenance information system***. ***Fundamentals of maintenance technology***. Technology for repair and reclamation of technical system components. Weak-point analysis and elimination. ***Maintenance management***. Maintenance planning. Maintenance quality control. Decision-making in management. Selection, training, organization, and allocation of human resources.

*Practical teaching*

Component reliability analysis. System reliability analysis. Preparation and defense of a seminar paper. Contact and non-contact temperature measurement – thermographic diagnostics. Mechanical vibration measurement.

**Literature**

Adamović, Ž., Savić, B., Stanković, N.: Osnovi održavanja mašina, Old Commerce, Novi Sad, 2003

Savić, B., Stanković, N., Ilić, B.: Održavanje mašina i opreme, Visoka tehnička škola strukovnih studija, Novi Sad, 2013

Savić, B., Stanković, N., Ilić, B.: Pouzdanost tehničkih sistema, Visoka tehnička škola strukovnih studija, Novi Sad, 2013

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**: Monologic, dialogic and interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 30 | | |
| Seminar paper/s | 20 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Machine elements**

**Teacher: Nenad Janjić**

**Course status: Compulsory**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

Introducing students to the application, form, dimensions, calculation, and utilization of machine elements.

**Learning outcomes**

Students will be capable of selecting and calculating machine elements, as well as managing their operation and maintenance.

**Course contents**

*Theoretical teaching*

***Introduction***: Engineering and product design of machines and machine components.
***Standardization***: General concepts. Preferred numbers.
***Tolerances***: Dimensional tolerances, geometrical tolerances, and surface roughness. Influence of temperature on tolerances.
***Working capacity of machine parts***: Loads, strains, stresses, and safety factors. Stress concentration. Critical stresses.
***Threaded joints***: Thread and screw pair. Power screws. Threaded connections.
***Shafts and axles***: Materials, loads, stresses. Preliminary and final calculations. Pins. Shaft journals.
***Splined joints***: Forms, loads, stresses, and safety factors.
***Keys and keyways***: Types and calculation.
***Bearings***: Types of bearings. Sliding bearings: types, materials, lubrication, and manufacturing. Rolling-element bearings – classification, types, designation, and application. Bearing installation, lubrication, sealing, assembly, and disassembly.
***Springs***: Bending, torsion, and compound springs.
***Couplings and brakes***: Classification and calculation. Rigid and flexible couplings. Friction couplings and brakes.
***Mechanical drives***: Friction drives – properties and forces. Kinematics and slip. Types and calculation. Gear pairs: Spur/helical, bevel, and hyperboloid gears. Tooth profiles and dimensions. Gear meshing.
***Load capacity of gear pairs***: Load capacity of spur/helical, bevel, and worm gear pairs. Loads, operating and critical stresses. Safety factors. Selection of basic geometric parameters and gear pair design.
***Belt drives***: Properties and types. Belt tensioning. Forces and stresses in the belt. Belt lifespan. Structural design of pulleys.
***Hazards and protection systems*** on machinery from the perspective of machine elements.

*Practical teaching*

Using concrete machine element specimens (gears, sprockets, bearings, couplings, shafts, axles, pins), students observe their characteristics and functionalities, and perform engineering calculations.

**Literature**

Kovačević S.: Mašinski elementi, VTŠ, Novi Sad, 2009
Ognjanović M.: Mašinski elementi, Mašinski fakultet Beograd, Beograd, 2011
Josimović Lj.: Rešeni ispitni i projektni zadaci iz mašinskih elemenata, materijal u elektronskoj formi, dostupno studentima, Društvo za TDS, Beograd, 2016
Plavšić, N.: Zbirka rešenih zadataka iz mašinskih elemenata, MF Beograd, 2017
Kuzmanović, S.: Mašinski elementi, zbirka zadataka, FTN Novi Sad, 2016

| **Active teaching classes: 75** | **Theoretical teaching: 45** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**: Monologic, dialogic and interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | |
| Practical work | | Oral exam | 50 |
| Interim exam/s | 30 | | |
| Seminar paper/s | 20 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Machine tools**

**Teacher: Vladimir Blanuša**

**Course status: Compulsory**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

To enable students to operate and utilize machine tools for metal cutting processing.

**Learning outcomes**

Acquired knowledge in the field of operation and utilization of machine tools for metal cutting processing.

**Course contents**

*Theoretical teaching*

Machine tools. General considerations. Classification of machine tools. Achieving primary and feed motions. Transmission systems, continuous and discontinuous variable transmissions.
Lathes and their classification. Universal lathes, multi-tool lathes, copying lathes, turret lathes, single-spindle and multi-spindle automatic lathes, vertical lathes. NC lathes, turning centers, flexible manufacturing cells for turning.
Milling machines, classification of milling machines, horizontal milling machines, standard horizontal milling machines, universal milling machines, vertical milling machines, multi-spindle milling machines, plano-milling machines, rotary table milling machines, profile milling machines for 2D and 3D copying, NC milling machines, milling centers, flexible manufacturing cells for milling.
Sawing machines, circular saws, hacksaws and bandsaws, power hacksaws.
Grinding machines and their classification, cylindrical grinding machines for external grinding (center-type and centerless), internal cylindrical grinding machines, universal cylindrical grinding machines.
Drilling machines, bench, pillar, gang, radial, coordinate (jig) boring, multi-spindle, NC drilling machines, and CNC drilling machines.
Production process, technological process, machining process, models of other systems. The position of metal cutting technology in modern manufacturing.
Metal cutting theory, turning processing, drilling processing, milling processing (determination of machining parameters).

*Practical teaching*

Exercises on the kinematic structure of machine tools and the calculation of machining parameters. Problem-solving and preparation for interim exams.

**Literature**

Kukić, S., Bukta, Z: Eksploatacija mašina alatki, Novi Sad, 1984
Stanković, P: Mašinska obrada metala rezanjem, Beograd, 1971
Mećanin, V: Alatne mašine sa numeričkim i kompjuterskim upravljanjem, Mostar, 1998
Blanuša, V.: Mašine alatke (elektronski materijal), VTŠSS-Novi Sad, 2021

| **Active teaching classes: 75** | **Theoretical teaching: 30** | **Practical teaching: 45** |
|---|---|---|

**Teaching methods**: Monologic, dialogic, interactive and laboratory.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Process devices**

**Teacher: Petra Tanović, Anita Petrović-Gegić**

**Course status: Elective**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

To introduce students to the equipment used in technological processes and provide them with a comprehensive understanding of their operating principles. The course covers the processes of sedimentation, mixing, comminution, solid material transport, heat transfer and exchange methods, distillation, and drying. Furthermore, it aims to equip students with the skills required to perform calculations related to heat balance, sedimentation, distillation, filtration, and heat exchange.

**Learning outcomes**

Students are qualified to perform engineering tasks and will thoroughly understand the operating principles of equipment used in technological processes. They possess essential knowledge of mechanical, thermal, and mass transfer operations necessary for professional practice in the process industry. Additionally, students will master the functioning of process equipment and be capable of performing calculations related to heat balance, heat exchange, particle sedimentation, filtration, drying, distillation, and other related operations.

**Course contents**

*Theoretical teaching*

***Introduction:*** Material and energy balance of technological processes. Mechanical operations. Homogeneous and heterogeneous systems. Gaseous heterogeneous systems. Separation of gaseous heterogeneous systems by sedimentation, gravity settlers, cyclones, scrubbers, wet scrubbing, filtration, and electrostatic precipitation. Liquid heterogeneous systems. Foams. Emulsions. Suspensions. Separation of liquid heterogeneous systems: emulsions and suspensions (by sedimentation and filtration). Devices for separating emulsions. Devices for separating suspensions. Mixing of liquids and solid materials. Mixing equipment (mixers with horizontal and vertical blades, propeller mixers). Comminution of solid materials by crushing and grinding. Jaw and cone crushers. Hammer mills and ball mills. Roller mills. Screening, sieves, and screens.

***Transport of Solid Materials:*** Belt, chain, screw, and apron/plate conveyors. Bucket elevators. Pneumatic transport. Hydraulic transport. Air transport.

***Heat Transfer Mechanisms:*** Heat transfer by conduction. Heat transfer by fluid flow – convection. Heat transfer by radiation. Heat sources and carriers. Devices for direct heat exchange. Devices for indirect heat exchange (heat exchangers). Cooling. Condensation and condensers. Evaporation and evaporators.

***Mass Transfer Operations:*** Fundamental laws. Distillation and rectification. Equipment for distillation and rectification. Drying and dryers. Material humidity and moisture content. Material and heat balance.

*Practical teaching*

Solving problems related to material and heat balances. Problem-solving exercises regarding particle sedimentation and filtration operations. Problems in the field of fluid flow and heat exchange. Exercises covering drying processes, as well as distillation and rectification.

**Literature**

Milanko, V: Procesni uređaji, Visoka tehnička škola strukovnih studija, Novi Sad, 2015
Milanko, V: Tehnološki procesi proizvodnje, Visoka tehnička škola strukovnih studija, Novi Sad, 2011
Đurić S., Stanojević P., Stepanov B., Radonjić J.: Procesni sistemi i postrojenja, FTN Novi Sad, 2015
Sovilj M. : Difuzione operacije, Tehnološki fakultet Novi Sad, 2004

| **Active teaching classes: 75** | **Theoretical teaching: 30** | **Practical teaching: 45** |
|---|---|---|

**Teaching methods**: Monologic, dialogic, interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Engines and motor vehicles**

**Teacher: Nenad Janjić**

**Course status: Elective**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

Acquiring basic knowledge and theoretical foundations regarding the design, operation, and application of internal combustion engines (ICE) and electrical machines, as well as the theory of motion, design, operation, and utilization of motor vehicles in traffic and transport systems.

**Learning outcomes**

Students will acquire knowledge of the fundamentals of the design, operation, and application of internal combustion engines (ICE) and electrical machines, as well as the theory of motion, design, operation, and use of motor vehicles in traffic and transport.

**Course contents**

*Theoretical teaching*

Introduction (history, classification, engine operating principle, and basic structural elements).
Fuels, energy carriers, and alternative fuels.
Engine kinematics.
Engine dynamics.
Engine thermodynamics.
Fuel and air supply systems in engines.
Engine lubrication system.
Engine cooling.
Auxiliary engine units.
Environmental standards for engine operation.
Classification of motor vehicles.
Kinematics and dynamics of motor vehicles.
Stability of motor vehicles.
Construction of motor vehicles.
Power transmission in motor vehicles.
Motor vehicle subsystems (wheels, steering mechanism, braking system, suspension).
Motor vehicle equipment.
Development perspectives of engines and motor vehicles.

*Practical teaching*

Problem-solving and practical exercises in the field of engines and motor vehicles, aligned with the theoretical teaching curriculum.

**Literature**

Filipović, I.: Motori i motorna vozila, materijal u elektronskoj formi, dostupno studentima, Tuzla, 2006
Janjić, N.: Tehnologije dijagnostikom motornih vozila, materijal u elektronskoj formi, dostupno studentima, Nova knjiga, Podgorica, 2013
Stefanović, A.: Drumska vozila, materijal u elektronskoj formi, dostupno studentima, Mašinski fakultet, Niš, 2010
Stefanović, A.: Motori sa unutrašnnjim sagorevanjem, materijal u elektronskoj formi, dostupno studentima Mašinski fakultet, Niš, 2006
Adamović Ž.: Dijagnostika putničkih automobila, ADMIN INSTITUT, Beograd, 2007
Kliner, I.: Motori sa unutrašnjim sagorevanjem, Mašinski fakultet Niš, 2006
Tomić, M.: Motori sa unutrašnjim sagorevanjem, MF Beograd, 2014
Janjić, N.: Motori i motorna vozila (elektronski materijal), VTŠSS Novi Sad, 2023

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods:** Monologic, dialogic, interactive, laboratory.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | |
| Practical work | | Oral exam | 50 |
| Interim exam/s | 30 | | |
| Seminar paper/s | 20 | | |

Back to top

**Study programme**: **Mechanical engineering**

**Course title: Technical systems management**

**Teacher: Petra Tanović, Đorđe Mihailović**

**Course status: Compulsory**

**Number of ECTS: 6**

**Prerequisite course: None**

**Course objective**

To enable the student to understand and manage the processes of management, automation, and robotics, and, with the acquired knowledge of economics, to rationally participate in the economic process within manufacturing and service enterprises in a market environment. The student learns to understand the structure of enterprise processes and modern approaches to production implementation.

**Learning outcomes**

Based on the mastered material, the student is able to integrate the function of technical systems management with economic and financial functions in various types of enterprises. Understands the mechanisms and factors of strategy creation. Understands and knows how to plan the financing of manufacturing or service activities.

**Course contents**

*Theoretical teaching*

Introduction to technical systems; Basic concepts and definitions. States of technical systems. Classification of production technologies. Basic processes in the enterprise and the functioning of the enterprise. Structure of the production process in a manufacturing enterprise. Basic types of production processes and provision of services. The impact of technological development on the relationship between humans, society and technology. Factors of production and principles of business; Forms of investment in production and cost calculation; Definition, reasons for existence, and business objectives of an enterprise; Legal forms of entities performing economic activities; Entrepreneurship and entrepreneurial venture; Business plan/Investment studies/Development projects; Financial part of the business plan; Market structures; Management and managers – definition and types; Marketing function in the enterprise; SWOT analysis; Strategic management; Operational management; Project management; Gantt chart; Indicators of technological progress of the enterprise; Methods for supporting technological innovations in an enterprise; Strategic technology management; Perspectives of technology development strategies. The impact of technology on national competitiveness. Technology transfer; Types and forms of technology transfer. Technology as a factor of economic growth. Innovative activity. The role of the information system for managing production and technological resources. Development of computer-integrated production.

*Practical teaching*

Preparation of cost calculations; Preparation of a business plan; Preparation of the financial part of the business plan; Analysis of legal forms of entities on specific examples; Preparation of SWOT analysis – case study; Preparation of Gantt chart; Project planning – case study.

**Literature**

Regodić, D.: Tehnički sistemi, Univerzitet Singidunum, Beograd 2011

Pokrajčić D.: Ekonomika preduzeća, Ekonomski fakultet Univertizeta u Beogradu, Beograd, 2016

Ćirović M. Redaktor: Strateški menadžment, Naučno društvo Srbije i Univerzitet Singidunum, Beograd, 2009

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**

Monologic, dialogic, interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 30 | | |
| Seminar paper/s | 20 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Specialist English**

**Teacher: Branka Petrović**

**Course status: Compulsory**

**Number of ECTS: 3**

**Prerequisite course: None**

**Course objective**

Mastering the structures and functions of the English language at an intermediate level and expanding professional vocabulary through field-specific topics and situations, alongside further development of speaking, reading, writing, and listening comprehension skills.

**Learning outcomes**

Communication at an intermediate level of English language proficiency (CEFR level B1).

**Course contents**

*Theoretical teaching*

Language functions: writing emails; interpreting technical data; professional telephone conversations; ordering and purchasing devices; writing a curriculum vitae (CV); applying for a job.

Grammatical structures: comparison of long and irregular adjectives; relative, possessive, indefinite, and reflexive pronouns; adverbs of manner; the gerund; Past Continuous, Present Perfect, Present Perfect Continuous, and Past Perfect tenses; the passive voice; reported speech (commands, as well as declarative and interrogative sentences without backshift of tenses); the three basic types of conditionals; question tags.

Vocabulary: words and expressions necessary for communication at an intermediate level of English proficiency, with an emphasis on field-specific situations and topics arising from the profession as presented in the textbook.

*Practical teaching*

Although separate practical classes are not explicitly scheduled, due to the nature of the course, to a certain extent – depending on the specific teaching units – lectures include activities that involve the practical oral and written application of the English language by the students.

**Literature**

Evans V., Dooley J., Wright S., Career Paths: Information Technology, Express Publishing, Newbury, UK, 2013

Lloyd Ch., Frazier J.A., Career Paths: Engineering, Express Publishing, Newbury, UK, 2011

Evans V., Dooley J., Rogers H.P., Career Paths: Art & Design, Express Publishing, Newbury, UK, 2013

Nastavni materijal predmetnog nastavnika

Dimitrijević N., Radovanović K.: Test Your English, zbirka testova za engleski jezik, Zavod za udžbenike i nastavna sredstva, Beograd, 1992

| **Active teaching classes: 30** | **Theoretical teaching: 30** | **Practical teaching:** |
|---|---|---|

**Teaching methods**

Combined method (monologue, dialogue, demonstration, illustration, and text-based method along with appropriate organizational forms: frontal, individual, group, pair, and team/interactive work).

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Modelling and 3D printing**

**Teacher: Nenad Janjić, Branko Savić**

**Course status: Compulsory**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

To introduce students to 3D volumetric modelling, preparation for 3D printing, and printing using various 3D printing technologies.

**Learning outcomes**

Students have acquired the knowledge to independently create 3D models, prepare them for printing, and print models using various 3D printing technologies.

**Course contents**

*Theoretical teaching*

Product lifespan. Product development. Rapid Prototyping, Rapid Tooling, Rapid Manufacturing, Reverse Engineering.
Time to market – the period required for a product to become available for sale.
Product lifecycle and computer applications in the product lifecycle (PLM).
Concurrent engineering.
Reverse engineering.
Types, significance, and application areas of three-dimensional models. Modern processes for three-dimensional model fabrication:
Liquid-based processes (Solidification of liquids): Stereolithography (SLA), Solid Ground Curing (SGC), Fused Deposition Modeling (FDM).
Powder-based processes: Selective Laser Sintering (SLS), 3D printing (3DP).
Solid-based processes: Laminated Object Manufacturing (LOM).
Application of 3D scanners in the design and fabrication of 3D models.
Modern three-dimensional modeling software and its capabilities: CAD, Inventor, 3ds Max, IronCAD, SolidWorks, Pro/ENGINEER, Creo Parametric, Rhinoceros.

*Practical teaching*

Designing three-dimensional models in Autodesk Inventor and creating technical documentation. Assembly design utilizing three-dimensional models. Designing kinetic models and assemblies with moving parts – operation and motion simulation. Frame design using standard components and frame analysis. Design of welded structures. Designing sheet metal models and components.
Creating animations and motion graphics.
Hands-on fabrication of 3D models using Binder Jetting (3D printing), Stereolithography (SLA), and Fused Deposition Modeling (FDM).

**Literature**

Janjić, N.: 3D modelovanje - osnove i zadaci, VTŠSS, Novi Sad, 2021
Plančak, M.: Brza izrada prototipova, modela i alata, FTN, Novi Sad, 2009
Dimitrijević, N., Janjić, Z., Janjić, N.: Zbirka zadataka iz CAD-a – Autodesk Inventor, VŠPSS u Vranju, 2012 (elektronsko izdanje).

| **Active teaching classes: 75** | **Theoretical teaching: 45** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods:** Interactive, demonstrative and laboratory.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | |
| Practical work | | Oral exam | 50 |
| Interim exam/s | 20 | | |
| Seminar paper/s | 30 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Graphic processes**

**Teacher: Branko Savić, Petra Balaban**

**Course status: Elective**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

Introducing students to graphic manufacturing processes, with a special focus on planographic, screen, relief, gravure, and digital printing techniques. Introducing students to the technology of manufacturing bookbinding products (books, magazines, pads, etc.).

**Learning outcomes**

Students are able to professionally perform tasks and duties related to graphic processes. They are qualified to analyze a graphic product and select the appropriate printing technique and finishing process (post-press graphic processing) for the graphic product.

**Course contents**

*Theoretical teaching*

Design of printing machines. Sheet and roll feeding devices. Pressure devices for offset, relief, and gravure printing. Sheet transport. Delivery units. Inking units. Printing defects. Printing pressure. Ink transfer equation.

Offset printing system. Printing form cylinder. Offset cylinder. Impression Impression cylinder. Dampening unit. Inking unit. Rotary offset printing techniques. Techniques for measuring ink film thickness on offset prints. Problems in offset printing.

Screen printing system. Screen printing machines. Print deformations in screen printing.

Printing unit for gravure printing. Form cylinder. Impression cylinder. Inking unit and doctor blade. Drying unit. Pad printing techniques.

Flexographic printing system. Anilox rollers (structure and form of the anilox roller). Ink transfer. Doctor blade units. Drying units. Analysis of a central impression (satellite-type) flexo press.

Digital printing. Plateless printing processes. Computer-to-Press / Computer-to-Print technologies. Functional components of Non-Impact Printing (NIP) technology. System components for Computer-to-Print. Electrophotography (principle, imaging, inking, impression, toner fixing, cleaning). Ionography. Printing unit. Imaging system. Magnetography. Imaging system. Inkjet printing. Continuous Inkjet. Drop-on-Demand Inkjet technologies. Thermography. Thermal transfer and thermal sublimation printing systems. Other digital printing techniques.

Classification and characteristics of materials, products, and basic post-press procedures. Sheet flattening. Cutting. Die-cutting. Creasing. Embossing. Perforation. Folding. Gathering. Wire stitching. Perfect binding. Mechanical processing of the spine, glue application, defects of perfect binding). Hardcover binding (sheet preparation, production and processing of the book block, case-making, and book finishing).

*Practical teaching*

Preparation and printing of materials in digital printing at the printing house of the Higher Education Technical School of Professional Studies in Novi Sad. The process of single-color and multi-color screen printing. Laboratory exercises for measuring specific print parameters using the measuring devices available at the school.

**Literature**

Savić, B, Balaban, P.: Grafički procesi - materijal u elektronskoj formi, VTŠSS, Novi Sad, 2021
Novaković, D. Dedijer, S.: Grafički procesi, Fakultet tehničkih nauka, Novi Sad, 2019
Novaković, D., Kašiković, N.: Digitalna štampa, FTN, 2013
Todorović, M.: Rotacije za ravnu, duboku i flekso štampu, Viša politehnička škola, Beograd, 2006
Kašiković, N., Novaković, D., Jurič, I.: Digitalna štampa-praktikum za vežbe, FTN, 2016

| **Active teaching classes: 75** | **Theoretical teaching: 45** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods:**

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 55 |
| Practical work | 10 | Oral exam | |
| Interim exam/s | 30 | | |
| Company visit | 5 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Work equipment safety**

**Teacher: Dušan Gavanski**

**Course status: Elective**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

The primary objective of the course is to introduce students to the operating principles, potential hazards, and protection systems of various machinery and transport vehicles. A specific objective of the course is to enable students to independently recognize and analyze hazards and protection systems on various machines and transport vehicles, and to determine whether the applied safety measures are adequate—specifically, whether the machine or transport vehicle is safe for operation.

**Learning outcomes**

The student is capable of recognizing and analyzing hazards and protection systems on various machines and transport vehicles, and based on this, drawing a conclusion on whether the machine or transport vehicle is safe for operation.

**Course contents**

*Theoretical teaching*

***General Overview of Machinery and Protection Systems***: Concept of machinery. Analysis of danger zones on machines. Methods of protection against injuries when working on machinery. ***Metal Cutting Machines***: Lathes. Drilling machines. Planing machines). Milling machines. Grinding machines. Basic movements, tools, hazards, and safety measures. ***Woodworking Machines***: Circular saw. Band saw. Surface planer. Thickness planer. Spindle moulder. Belt sander. Vertical panel saw. Combination woodworking machine. Basic movements, tools, hazards, and safety measures. ***Metal Forming Machines***: Presses. Shearing machines. Basic movements, tools, hazards, and safety measures. ***Rubber and Plastics Processing Machines***: Two-roll mills. Calenders. Injection moulding machines. Extruders. Basic movements, tools, hazards, and safety measures. ***Packaging and Palletization Machines***: Principles of unit load forming. Mechanization and automation of the packaging process. Primary (individual) packaging machines. Secondary (transport) packaging machines. Palletizing machines. ***Organization of Transport***: Concepts and definitions. Transport. Warehousing. Cargo handling. Material handling equipment. Goods handling and packaging. Pallets and palletization. Containers and containerization. ***Intermittent-Motion Floor Transport Equipment***: Hand trucks. Lift platforms. Manual pallet jacks. Forklifts. ***Continuous-Motion Transport Equipment***: Conveyors with traction elements. Conveyors without traction elements. Pneumatic conveyors. Hydraulic conveyors. Computer-controlled conveyors. Protective elements on conveyors. Industrial robots and automated guided vehicles (AGVs). ***Intermittent-Action Lifting Equipment***: Bridge-type cranes. Jib cranes. Mobile slewing cranes. Tower and floating cranes. Chains and ropes. Hooks and shackles. Slings, cargo platforms, clamps, lifters, grippers, and spreader beams. Electromagnetic lifters and grabs. Drums, sheaves, and pulley blocks. Braking devices. Bumpers and buffers. Safety devices. Control devices and operator stations. Stairways, approaches, walkways, and platforms. Hazards in crane operations. Signs, warnings, and instructions. Personal protective equipment (PPE).

*Practical teaching*

Hazard and protection system analysis on machinery and transport equipment – case studies: real-world examples and practical applications. Hazards and protection systems on graphic machinery: Practical training conducted in the Laboratory for Graphic Engineering and Design. Preparation and defence of a seminar paper. Risk assessment for specific workplaces: Risk assessment analysis for a lathe operator and a forklift operator.

**Literature**

Gavanski, D.: Mašine za obradu metala rezanjem – opasnosti i mere zaštite, skripta, Novi Sad, 2014. Gavanski, D.: Mašine za obradu i preradu drveta – opasnosti i mere zaštite, skripta, Novi Sad, 2014.
Janković, Ž.: Sistemi zaštite na mašinama – koncepcijska analiza, Univerzitet u Nišu, Fakultet Zaštite na radu, Niš, 1999.
Grupa autora: Bezbednost i zdravlje na radu, monografija, knjiga 1, Tempus, Joint Project 41045_2006, Mašinski fakultet u Kragujevcu, 2009.
Gavanski, D.: Bezbednost u unutrašnjem transportu, skripta, Visoka tehnička škola strukovnih studija, Novi Sad, 2021

| **Active teaching classes: 60** | **Theoretical teaching: 30** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods:** interactive, demonstrative**.**

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | |
| Practical work | | Oral exam | 50 |
| Interim exam/s | 40 | | |
| Seminar paper/s | 10 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Machine tool programming**

**Teacher: Ranko Antunović, Aleksandar Čabrilo**

**Course status: Elective**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

To train students in the process of programming machine tools for metal cutting, machines for unconventional processes, and CNC punch presses.

**Learning outcomes**

Ability to professionally perform duties and tasks that are functionally and substantively related to machine tool programming.

**Course contents**

*Theoretical teaching*

Structure of numerically controlled machine tools, definition of numerical control. Basic mechanical system of machine tools. Drive and transmission system. Measuring system. Control system. Manual programming of machine tools. Programming phases. Designing the basic machining sequence. Elaboration of individual machining phases (detailing). Defining the control program. Coordinate systems. Process functions. Auxiliary functions. Machining cycles. Subprograms and macros.

Introduction to fixtures and jigs: purpose and application, classification of fixtures, fixture elements, manufacturing, technical drawings, and fixture materials.

Positioning, clamping, fixture elements, fixture design. Turning fixtures, milling fixtures, broaching fixtures. Grinding fixtures and tool holders. Fixtures for threading and gear cutting. Assembly fixtures. Economic analysis and optimization of fixture design and application.

Turning tools. Drilling tools: drill bits, countersinks, and reamers. Threading tools. Milling cutters. Grinding tools.

Preparation of the clamping plan, machining plan, and tooling plan. Machine tool programming: Programming CNC lathes, programming CNC milling machines, laser programming, and CNC punch press programming. Manual and computer-aided programming.

*Practical teaching*

Programming of specific machine tools (examples of manual and computer-aided programming).

**Literature**

Zeljković M., Borojev, Lj., Tabaković, S., Antić, A., Živković, A: Programiranje numerički upravljanih mašina alatki za obradu rezanjem, Fakultet tehničkih nauka, Novi Sad, 2010

Čabrilo, A.: Programiranje mašina alatki, elektronski materijal, 2023

| **Active teaching classes: 75** | **Theoretical teaching: 45** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods:**

Monologic, dialogic, interactive, and demonstrative.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | | Oral exam | |
| Interim exam/s | 50 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Air, water and soil protection**

**Teacher: Anita Petrović**

**Course status: Elective**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

To provide students with fundamental knowledge in the protection of air, water, and soil, including contamination pathways, quality analysis, and purification treatment.

**Learning outcomes**

Students are able to participate in resolving issues related to quality control and the protection of air, water, and soil resources, as they are familiar with the primary pollutants in these media. They understand detection methods and the monitoring of specific parameters, and have acquired practical skills for laboratory analysis of air, water, and soil. Furthermore, students are capable of analyzing and interpreting results to determine the source of pollution. They are also familiar with emission control methods, including air and water purification technologies and soil remediation techniques.

**Course contents**

*Theoretical teaching*

Air: Importance of air, sources, and types of air pollution. Pollutants – typical and specific; characteristics; sources of origin, effects on the human body, and the entire environment. Air quality monitoring. AQI (Air Quality Index). Air sampling, detection methods, and characterization of specific air quality control parameters. Air pollution control focusing on various techniques for removing specific pollutants. Legal regulations and standards in air protection management.

Water: Importance of water and the issue of surface water pollution at local and global levels. Pollution control in water bodies. Water quality control parameters. Water sampling, parameter measurement methods, and their characteristics. Classification of wastewater. Municipal, industrial, and thermal power plant wastewater. Wastewater treatment methods. Drinking water: quality requirements and pollution issues. Drinking water quality control. Drinking water treatment methods. Legal regulations and standards in water protection management.

Soil: Importance of soil. Soil structure. Soil properties. Threats to soil. Types of erosion. Loss and destruction of fertile soil. Surface mining of mineral resources. Phases of soil damage (degradation and destruction). Soil degradation and pathways of degradation. Complete exclusion of soil from its primary function. Sources of soil pollution. Industry as a source of soil pollution. Impact of mineral resource exploitation and groundwater extraction on soil. Soil pollution from agricultural production. Acid rain as a soil pollutant. Soil pollution from wastewater. Traffic as a soil pollutant. Impact of accidental situations on soil pollution. Landfills as soil pollutants. Radioactive soil contamination. Soil remediation and reclamation. Phytoremediation.

*Practical teaching*

Laboratory exercises are closely linked to the practical development of theoretical units to ensure hands-on laboratory experience in this field. Air sampling and determination of particulate matter (dust) and volatile organic compounds (VOCs) concentrations. Gas analysis using the Orsat apparatus. Measurement of pH and electrical conductivity in water. Determination of chemical oxygen demand (COD) in water. Determination of chlorides in water. Photometric and spectrophotometric detection of specific pollutants in water. Soil sampling and sample preparation for analysis. Sedimentation methods (particle-size analysis). Qualitative and quantitative detection of chlorides, sulfates, bicarbonates, humus, phosphorus, and heavy metals in soil.

**Literature**

Petrović Gegić, A., Božović, T: Zagađenje i zaštita vazduha, Visoka tehnička škola strukovnih studija Novi Sad, Novi Sad, 2014
Petrović Gegić, A., Božović, T: Zagađenje i zaštita vode, Visoka tehnička škola strukovnih studija u Novom Sadu, Novi Sad, 2012
Đukanović, J., Bojanić, V: Aerozagađenje, Institut zaštite i ekologije, Banja Luka, 2000
Tomašević-Pilipović D., i saradnici.: Zagađivanje voda, PMF , Novi Sad 2015
Tanović, P., Božović, T: Analiza zemljišta, praktikum, VTŠ, Novi Sad, 2015
Novaković V., Tomić A., Nikolić N., Petrović D.: Zagađenje i zaštita zemljišta i podzemnih voda, Feljton, Novi Sad, 2018

| **Active teaching classes: 75** | **Theoretical teaching: 45** | **Practical teaching: 30** |
|---|---|---|

**Teaching methods**: Monologic, dialogic, interactive, demonstrative, practical.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | 20 | Oral exam | |
| Interim exam/s | 30 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Work practicum**

**Teacher: Branko Babić, Ivan Bulatović, Jovana Kopanja**

**Course status: Compulsory**

**Number of ECTS: 7**

**Prerequisite course: None**

**Course objective**

To introduce students to basic occupational health and safety measures and fire safety protocols in order to prevent workplace injuries and fatalities, while familiarizing them with the applicable legal regulations and laws related to launching a business venture. The course aims to enable students to effectively source information regarding government subsidies and financial assistance for first employment and startup initiatives. Furthermore, students will gain insight into the specific procedures and practical examples of business registration, exploring realistic opportunities, development phases, and entrepreneurial prospects within relevant industries. Finally, through hands-on exercises in specialized fields, students will acquire practical experience on advanced machinery and equipment not available within the institution, thereby preparing them for professional practice and direct integration into modern production plants.

**Learning outcomes**

Upon successful completion of the course, students will possess a foundational knowledge of occupational health and safety regulations and fire safety protocols, enabling them to implement prescribed personal protection measures in the workplace and apply the code of business conduct. Furthermore, students will understand legal instruments used for securing contracts, such as loan and current account agreements, and will master the formal procedures required to establish their own company. They will be able to evaluate realistic opportunities, development phases, and entrepreneurial potential within relevant industries. Finally, students will acquire practical, hands-on experience by operating advanced machinery and specialized equipment not available within the institution, thoroughly preparing them for professional practice and seamless integration into modern production facilities.

**Course contents**

*Theoretical teaching*

1. Training students in the field of occupational safety and health (OSH) to ensure safe participation in work processes and environments. Through professional OSH training, students acquire foundational knowledge regarding the obligations and responsibilities of employers, the rights and duties of employees, the organization of workplace safety, and the personal protective equipment used in work processes. During their practical work within the company, students apply this knowledge to minimize the risk of workplace injuries and fatalities.
2. Fire safety training provides students with fundamental knowledge about fire behavior, combustion products, smoke toxicity, fire classes, and safe extinguishing techniques. It covers preventive measures, alerting Fire and Rescue Services, and operating portable fire extinguishers. Students apply and practice these skills within a limited, controlled scope during their practical placement.
3. Individual organizational characteristics, corporate representation, ownership and property relations, and special regulations governing internal company relations.
4. Cash deposits, savings deposits, loan agreements, and current account contracts.
5. Core rules of business etiquette, dress code, principles of ethics and integrity, conflict resolution mechanisms in professional relationships, and strategies for achieving business goals and navigating diverse workplace scenarios.
6. Preparation for establishing a business and the foundations of the regulatory framework, including: the Constitution of the Republic of Serbia, the Labor Law, the Law on Companies, the Law on the Registration Procedure with the Serbian Business Registers Agency (APR), the Law on Safety and Health at Work, the Law on Mandatory Social Security Contributions, the Law on Health Care, the Law on Pension and Disability Insurance, the Law on Health Insurance, and relevant bylaws issued by the Ministry of Labor.
7. The concept and legal nature of trade secrets, and their relationship with the protection of exclusive intellectual property rights.
8. Students undergo a practical knowledge assessment based on the first two topics, which serves as a prerequisite for implementing prescribed safety and security measures during their company placement.

*Practical teaching*

Students deliver presentations on the procedures and practical examples of launching their own business. The course also includes company site visits to help students understand real-world opportunities, development phases, and the broader potential of entrepreneurship. Within these partner enterprises, students conduct practical exercises in relevant fields, operating modern machinery and advanced equipment not available within the institution. This hands-on approach ensures that students are thoroughly prepared for their professional practice and ready to operate within modern production facilities.

**Literature**

Zakon o bezbednosti i zdravlju na radu („Sl. glasnik RS“, br. 35/2023)
Zakon o zaštiti od požara, Službeni glasnik RS, broj 111/2009, 20/2015, 87/2018 i 87/2018 – dr. zakoni.
Normativno-pravna regulativa iz oblasti rada
Marković, S., Popović, D.: Pravo intelektualne svojine (Beograd, Pravni fakultet univerziteta u Beogradu), 2022
Ljubojević, G., Milošević, I.: Poslovno pravo (Novi Sad, Visoka poslovna škola strukovnih studija), 2020
Vernart, B.: Međunarodno pravo i poslovanje (Novi Sad, Visoka poslovna škola strukovnih studija), 2022

| **Active teaching classes: 120** | **Theoretical teaching: 60** | **Practical teaching: 60** |
|---|---|---|

**Teaching methods**: Monologic, dialogic, interactive, demonstrative.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | 5 | Written exam | 50 |
| Practical work | 15 | Oral exam | |
| Interim exam/s | 30 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Theoretical and experimental bases of professional work**

**Teacher: Božo Ilić, Jovana Kopanja, Branko Savić**

**Course status: Compulsory**

**Number of ECTS: 9**

**Prerequisite course: None**

**Course objective**

Introduction of students to the methodology of producing various types of professional papers. Training students for engineering research in practice, as well as for conducting experimental and other types of research using various scientific and professional methods.

**Learning outcomes**

Upon successful completion of the course, students will be able to independently produce various types of professional papers by effectively applying diverse scientific and professional research methodologies. Additionally, students will demonstrate the ability to conduct experimental and other engineering research projects using advanced methodological frameworks.

**Course contents**

*Theoretical teaching*

Basic concepts of science and publication. Scientific papers. Scientific versus professional papers. Types of professional papers (Final paper, Specialist paper, Project, Technical study, Professional report, etc.). Methodology for writing professional papers: Selecting a research topic; Choosing and reviewing literature (collecting relevant data on the addressed problem); Structuring the paper (preface, table of contents, introduction, main body, conclusion, literature, appendices). Core rules for drafting professional papers. Scientific and professional methods in research: Analysis method. Synthesis method. Generalization method. Proof method. Refutation method. Comparative method. Statistical method. Sampling method. Mathematical method. Modeling method. Cybernetic method. Experimental method. Counting method. SWOT analysis. Organization of research applying various methodological frameworks. Practical application: conducting experimental and alternative research types relevant to the student's study programme, using real-world examples and diverse scientific and professional tools. Engineering foundations and engineering decision-making.

*Practical teaching*

A portion of the instruction for this course is conducted within a host company where students undergo professional internships and perform various activities directly related to their study program. During this internship period, students gain practical experience and familiarize themselves with business, production, and technological systems, specifically focusing on design, development, production, research, and testing. Throughout their practical placement, students maintain an internship logbook, recording descriptions of their tasks, conclusions, and observations. Upon completing the practical work, students compile their findings into a final report structured as a seminar paper.

**Literature**


Ilić, B., Savić, B.: Teorijske i eksperimentalne osnove stručnog rada, Visoka tehnička škola strukovnih studija u Novom Sadu, Novi Sad, 2022

Segedinac, T.: Teorija inženjerskog eksperimenta, Visoka tehnička škola strukovnih studija u Novom sadu, Novi Sad, 2012

Kovačević, S.: Teorijske i eksperimentalne osnove specijalističkog rada, Visoka tehnička škola strukovnih studija u Novom Sadu, Novi Sad, 2012

Adamović, Ž., Vulović, S.: Metodologija naučno-istraživačkog rada, Društvo za tehničku dijagnostiku Srbije, Beograd, 2011

Adamović, Ž., Nadrljanski, Đ.: Metodologija naučno-istraživačkog rada – Statističke metode u istraživanju, Društvo za tehničku dijagnostiku Srbije, Pedagoški fakultet, Sombor, 2011


| **Active teaching classes: 150** | **Theoretical teaching: 90** | **Practical teaching: 60** |
|---|---|---|

**Teaching methods**: Monologic, dialogic, interactive.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | 50 |
| Practical work | 20 | Oral exam | |
| Interim exam/s | 30 | | |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Professional practice**

**Teacher: Head of the study programme**

**Course status: Compulsory**

**Number of ECTS: 4**

**Prerequisite course: None**

**Course objective**

Acquiring and applying practical knowledge related to the study programme within the host organization, specifically for the purpose of drafting the final thesis.

**Learning outcomes**

Practical experience in the application and use of knowledge and skills acquired during undergraduate studies. Understanding of the work processes, operational structures, and management of the host company. Data collection and analysis necessary for drafting both the preliminary thesis and the final thesis.

**Course contents**

Professional practice is carried out in the sixth semester of basic professional studies. It is conducted within manufacturing, service, or other relevant business organizations, following general and individual programme contents designed for final thesis preparation, as agreed upon by the company co-mentor, the institution's mentor, and the student. Students may also complete their professional practice directly at the Higher Technical School of Professional Studies in Novi Sad (the Institution), according to a pre-determined and approved plan. All relevant forms regarding professional practice are available to students registered for the course.

Throughout the internship, students perform both general and specialized tasks. General tasks require students to familiarize themselves with the company's history, organizational structure, production or service portfolio, and overall work processes. Specialized professional tasks are jointly defined by the company co-mentor and the mentor. These tasks represent thematic units that students have already studied during their coursework and are now applying under practical conditions within the selected company. The mentor and co-mentor are responsible for precisely defining work assignments and obligations to familiarize students with the organizational structure, work processes, technology, quality control procedures for products and services, and methodologies for data collection and processing related to the preparation of the final thesis. The company co-mentor cooperates with the student on a daily basis, providing guidance and monitoring progress. During the placement, students maintain an Internship Logbook.

Assigned work tasks should enable students to actively apply the knowledge acquired throughout their studies, ensuring effective training for their future profession. Upon completing the internship, students submit a final report that corresponds in content and form to the instructions provided at the beginning of the placement.

**Literature**

Technical documentation from the company and other relevant literature agreed upon between the student, the company co-mentor and the mentor.

**Active teaching classes: 90**

**Teaching methods**: Practical, laboratory, individual work.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | |
| Practical work | 45 | Oral exam | |
| Interim exam/s | | Exam | 55 |
| Seminar paper/s | | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Preliminary thesis**

**Teacher: Head of the study programme/Mentor**

**Course status: Compulsory**

**Number of ECTS: 2**

**Prerequisite course: None**

**Course objective**

Developing the ability to identify and define problems and communicate with the mentor. Familiarization with practical methodologies applicable to the selected field of study. Integrating, upgrading, and practically applying the knowledge acquired throughout the studies. Preparation for the writing of the final thesis.

**Learning outcomes**

Through independent and mentored research, the student defines and elaborates upon the initial topic of the final thesis, culminating in a written thesis proposal and an oral defense of a detailed research plan. Consequently, the student develops the ability to conduct analysis and identify problems within the given topic, demonstrating full readiness to write the final thesis.

**Course contents**

The course is taught through independent professional research and mentoring, during which the student defines the initial topic of the final thesis and elaborates it in detail, leading up to a written proposal and an oral defense of a detailed plan for the preparation of the final thesis.

Upon receiving the topic and research assignment, and through regular consultations and progress reporting, the student reviews relevant academic literature, past final theses, and other publications in a related field. The student then conducts preliminary analyses to better delineate the assigned research problem.

In the second phase, the student studies the nature, structure, and complexity of the problem in more detail. The student actively searches for published knowledge within the broader topic of the assigned work, and plans and conducts preliminary research or conceptual solutions in order to better conceptualize the task and direct it toward implementation and finalization. In this way, the student draws conclusions about possible solutions, chooses a methodology/technology, and plans in detail the organization and execution of the main analyses or applications of the selected technology when writing the final thesis. During this process, the student regularly consults with the mentor, and if necessary, with other faculty members of the School. The goal of the activities is to gain the necessary experience for problem-solving and to identify opportunities for applying previously acquired knowledge in practice.

At the end of the research work, the student writes a Preliminary Thesis Paper. The quality of the written proposal is assessed by the mentor/head of the study programme, and it is defended orally (viva).

**Literature**

Textbooks in the chosen field, papers from professional journals, technical documentation and company records, software tutorials, past final thesis, etc.

**Active teaching classes: 30**

**Teaching methods**: Practical, research, mentoring.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | |
| Practical work | | Oral exam | |
| Interim exam/s | | Preliminary thesis (viva) | 50 |
| Preliminary thesis (preparation) | 50 | | |

Back to top

**Study programme: Mechanical engineering**

**Course title: Final thesis**

**Teacher: Mentor**

**Course status: Compulsory**

**Number of ECTS: 8**

**Prerequisite course: Passed all courses from the study programme**

**Course objective**

Systematization of theoretical and practical knowledge acquired throughout the study programme, enabling students to develop decision-making and practical problem-solving skills. Documentation of the work done in a written format and the public defense (viva) of the results of the work.

**Learning outcomes**

The capacity to analyze and resolve practical problems. Skills in presenting research results through both written reports and oral presentations.

**Course contents**

Upon passing all examinations, the student proceeds to draft the final thesis. This is an applied research paper through which the student becomes familiar with practical problem-solving and research methodologies within one of the fields of the study programme. All procedures and forms related to the final thesis are available on the School's website.

The mentor is an active participant in all phases of writing the final thesis, and if necessary, includes a co-mentor from the company (from the student's professional practice) and other faculty mambers of the School.

In addition to a comprehensive review of the existing literature and/or legal and technical regulations in the chosen field, the final thesis should include at least one of the following elements: an analytical, computational, design, or experimental/practical aspect.

The student completes the final thesis independently, and it is highly desirable that the work is linked to specific knowledge acquired during professional practice. The student drafts the final thesis based on the detailed execution plan previously presented in the Preliminary Thesis. In doing so, the preliminary experiments, analyses, or software solutions obtained during the research for the Preliminary Thesis are finalized to achieve the definitive results or programs. Subsequently, the student prepares the final thesis in the prescribed format, which includes the following chapters: Introduction, Thesis Objective, Elaboration of the Topic, Conclusion, and Literature.

After submitting the written version of the thesis, a verification of fulfillment of conditions follows, according to the procedure given by the *Regulations on Topic Application, Preparation, and Defense of the Final Thesis on Bachelor, Specialist, and Master Studies at the Higher Education Technical School of Professional Studies*. Then the student proceeds to the oral presentation and defense of the final thesis. The viva is public, and the thesis is defended before a committee.

**Literature**

Textbooks in the chosen field, papers from professional journals, technical documentation and company records, software tutorials, past final thesis, etc.

**Number of classes: 45**

**Teaching methods:** Mentoring, practical, laboratory, individual work.

**Assessment (maximum number of points 100)**

| **Pre-exam obligations** | **Points** | **Course exam** | **Points** |
|---|---|---|---|
| Active participation in classes | | Written exam | |
| Practical work | | Oral exam | |
| Interim exam/s | | Final thesis (viva) | 50 |
| Seminar paper/s | | | |
| Final thesis (preparation) | 50 | | |

Back to top