University of Belgrade
Faculty of Mechanical engineering

Course catalog
B.Sc. (undergraduate) academic studies

Belgrade
November, 2012
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Mechanical Engineering Praxis
Skill Praxis B - MFB
Mechanical Engineering Praxis

**ID:** BSc-0358
**teaching professor:** Милош В. Марко
**level of studies:** B.Sc. (undergraduate) academic studies
**ECTS credits:** 5
**final exam:** written
**parent department:** MFB

**goals**

Introduction of the students about all mechanical fields which are the subject of studying in Mechanical faculty from the point of view of practical work in each particular field: Control Engineering, Biomedical engineering, Naval architecture, Aerospace engineering, Design in mechanical engineering, Railway mechanical engineering, Welding and welded structures, Engineering of biotechnical systems, Industrial engineering, Information technologies, Motor vehicles, Internal combustion engines, Food industry engineering, Production engineering, Process engineering and environment protection, Weapon systems, Thermal power engineering, Material handling, constructions and logistics, Thermal science engineering, Hydropower engineering, Computational Engineering.

**learning outcomes**

The students will be introduced about practical work in all fields which are the subject of studying in Mechanical faculty.

**theoretical teaching**

Presentation of the any particular field - study module at Mechanical faculty.

**practical teaching**

**prerequisite**

**learning resources**

**number of hours**

**total number of hours:** 29

**active teaching (theoretical)**

lectures: 0

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**
check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 29

assessment of knowledge (maximum number of points - 100)
feedback during course study: 10
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 90
requirements to take the exam (number of points): 30

references

professor's handouts
Skill Praxis B - MFB

ID: BSc-0022

**teaching professor:** Милош В. Марко

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 1

**final exam:** project design

**parent department:** MFB

**goals**

Practical experience in ambient similar to the ambient where the graduated student - mechanical engineer will realize his own professional carrier. Recognizing the basic functioning of the business systems especially in domain of development, design and manufacturing of the mechanical systems.

**learning outcomes**

Students can reach practical experiences about the organization and functioning the business systems that deal in mechanical engineering. Student can be introduced in business communication, design processes, development processes and manufacturing.

**theoretical teaching**

**practical teaching**

The skill praxis is organized in a way which is the most appropriate for the student. Practical work must be realized in the company where the mechanical engineering is the primary occupation. What the student will work, see or follow must be defined in coordination with the professor. Generally, student can realize practical work in: manufacturing companies, design companies, companies which work maintenance in mechanics or in laboratories that belong to the Mechanical faculty. After finishing the practical work, the student must prepare the Report and this Report needs to be defended in front of professor.

**prerequisite**

**learning resources**

Initial resources are laboratories that belongs to the Mechanical faculty.

**number of hours**

total number of hours: 46

**active teaching (theoretical)**

lectures: 0

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 100
requirements to take the exam (number of points): 0

**references**
aerospace engineering

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Aerodynamics
Aerodynamics
Aircraft propulsion and systems
Computational methods in aeronautics
Design and Aircraft Production Technology
FEM Analysis
Fundamentals of aerotechnics
Introduction to engineering simulations
Introduction to engineering simulations
Light and Composite Aircraft Structures
Light and Composite Structures
Mechanics of Flight
professional practice B - AVIATION
Structural Analysis of Flying Vehicles
Theory of Elasticity
Windturbines
AERODYNAMIC CONSTRUCTIONS

ID: BSc-0429

**teaching professor:** Стефановић А. Зоран

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** aerospace engineering

**goals**

The aim of this course is to introduce students to basic concepts in applied aerodynamics. The emphasis is on the aerodynamics of aircraft, but will consider the role in the construction of wind turbines, cars, etc. Concept of aerodynamic loads will be analyzed and its importance not only when it comes to aircraft parts, but also buildings, bridges, etc.

**learning outcomes**

After passing the course student is expected to discuss the basic laws of aerodynamics and know how to apply them to solve practical problems. At the same time it is expected that student recognize problems, and implementation of these results in other areas of technics.

**theoretical teaching**

Course content consists of theoretical and practical part. Theoretical part analyzes the following topics:
- The role and the case study of aerodynamics, slender body concept, aerodynamic forces and aerodynamic torque, etc.;
- Airfoil (basic geometric features, characteristics, notation and families);
- Wings (geometric and aerodynamic characteristics), comand surfaces (flaps, brakes, ailerons, slats, etc...);
- Aircraft aerodynamic scheme;
- Structural and aerodynamic characteristics of the propellers, rotors and wind turbines.

**practical teaching**

Practical part of course demonstrate the numerical examples in the area covered in the lectures. Practical work of students is realized through a virtual classroom available 24 hours (internet - software MOODLE). In the workshop students have approach to the professor's written notes, lectures, assignments and tests for practice. Practical training includes two homeworks of the student (an individual and a collective in group within the group to which students are divided). In the first student perform calculation of the aerodynamic characteristics of the airplane, and the second is the essay that exposes the public. In practical training exists excursion - students visit to Aviation Museum - Surčin.

**prerequisite**

None

**learning resources**

In the Course exists a virtual classroom on the Internet. MOODLE is used to program. Students are entered electronically into a classroom and have approach to the professor notes, quizzes and additional material advised by professor.
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 5
seminar works: 0
project design: 0
consultations: 10
discussion and workshop: 5
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 3
check and assessment of projects: 2
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 15
test/colloquium: 15
laboratory exercises: 0
calculation tasks: 20
seminar works: 20
project design: 0
final exam: 30
requirements to take the exam (number of points): 25

references
Aerodynamics

**ID:** BSc-0085  
**teaching professor:** Пешић М. Славко  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** aerospace engineering

**goals**

1. Introduction to basic laws of aerodynamics and its application in solving practical problems.
2. Introduction to the wind tunnels, their use and their role in the aerodynamic design of aircraft.
3. Introduction to basic aerodynamic aircraft scheme.
4. Introduction to basic aerodynamic characteristics of aircraft.

**learning outcomes**

1. Mastering the basic theoretical knowledge of aerodynamics.
2. Application of learned theoretical knowledge in the practical problems solving.
3. Apprehension of the basic aerodynamic aircraft scheme.
4. Apprehension of the basic aerodynamic characteristics of aircraft.

**theoretical teaching**

Lesson 1: Modeling of flow field  
Lesson 2: The equation of energy in compressible flow  
Lesson 3: The law of conservation of mass in the compressible flow  
Lesson 4: The waves in compressible flow  
Lesson 5: The expansion wave  
Lesson 6: The normal shock wave  
Lesson 7: Oblique shock wave  
Lesson 8: Flow through the nozzle  
Lesson 9: Speed measurement in the compressible flow  
Lesson 10: Airfoils in the supersonic flow field  
Lesson 11: Wind tunnels  
Lesson 12: Methods of measurement in wind tunnels  
Lesson 13: Aerodynamic aircraft scheme  
Lesson 14: Aerodynamic characteristics of aircraft

**practical teaching**

In the practical part of the course basics laws of aerodynamics are used for solving and analysis of the characteristic numerical examples.  
Practical work of students is carried out through the mandatory lab classes as well as through the virtual workshop (program MOODLE) which is available 24 hours. In the virtual workshop written notes of lectures, exercises and test problems are available for students to check their current knowledge.  
Practical part of the course includes two different homeworks. A homework assignment for each student individually, and a group homework assignment, which is carried out in small groups (up to five students per group).  
Practical training includes an excursion, a tour of the wind tunnel complex in the aerodynamics sector of the Military Technical Institute.
prerequisite

No special conditions

learning resources

Lectures in electronic form, the demo movies, and simulations available through the virtual workshop (program MOODLE), internet resources.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 5
seminar works: 0
project design: 0
consultations: 10
discussion and workshop: 5
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 2
check and assessment of projects: 3
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 15
test/colloquium: 25
laboratory exercises: 0
calculation tasks: 0
seminar works: 15
project design: 15
final exam: 30
requirements to take the exam (number of points): 21

references
Aerodynamics

ID: BSc-0610
teaching professor: Костић А. Иван
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 2
final exam: written
parent department: aerospace engineering

goals

The aim is that after attended course in Aerodynamics, students become familiar with the basic laws of aerodynamics, and their application in slowing practical problems. Specific issues and phenomena of compressible flow are analyzed. Students acquire knowledge about the design concepts of aircraft for different speed domains, as well as about the fundamentals of the road vehicle aerodynamics. Within the course, students also become familiar with the basics of experimental aerodynamics, and its application in aeronautical and non-aeronautical testing.

learning outcomes

After accomplishing the course, students acquire knowledge in the domain of aerodynamics, with special attention paid on compressible flow domain, as well as the understanding of basic aircraft design schemes and automobile aerodynamics. They also gain knowledge about the basics of experimental aerodynamics, and its application not only in the domain of aviation, but also in other technical branches.

theoretical teaching

Lesson 1: Flow field modeling
Lesson 2: Compressible flow and waves in compressible flow
Lesson 3: Aerodynamic design schemes of aircraft and road vehicles
Lesson 4: Subsonic, transonic and supersonic wind tunnels
Lesson 5: Wind tunnel measurements

practical teaching

In practical part, presented theoretical laws are demonstrated through the solutions and analyses of selected numerical problems. Beside the mandatory lab classes, practical activities are also accomplished through the virtual workshop (program MOODLE), which is available 24 hours. In the virtual workshop, written notes of lectures, exercises and test problems are available for students to check their current knowledge. Practical part includes consulting and discussions of one homework, which is accomplished through smaller student groups (of up to five students per each group). Practical training also includes an excursion, a tour of the wind tunnel complex in the aerodynamics sector of the Military Technical Institute.

prerequisite

No special conditions, but attended course in Aerodynamic Design is recommended.

learning resources

Lectures in electronic form, demo movies and clips, and graphical simulations available through the virtual workshop (program MOODLE), internet resources.

number of hours
total number of hours: 30

active teaching (theoretical)

lectures: 12

active teaching (practical)

auditory exercises: 5
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 5
discussion and workshop: 2
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 1
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 18
test/colloquium: 32
laboratory exercises: 0
calculation tasks: 0
seminar works: 20
project design: 0
final exam: 30
requirements to take the exam (number of points): 21

references
Aircraft propulsion and systems

ID: BSc-0053

**teaching professor:** Јанковић М. Јован

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** aerospace engineering

**goals**

Subject task is to introduce students with aircraft equipment and power systems, their functions, structures and basic principals. Subject enables global introduction of students into all aircraft and power systems, and its integrity.

**learning outcomes**

By the subject student gets knowledges and understandings about existing aircraft and power systems of various types. These knowledges enables understandung of aircraft and power systems if they are oriented to other aeronautical fields, or to further specialization in this area.

**theoretical teaching**

Hidraulic aircraft systems, Fuel aircraft systems, Pneumatic aircraft systems, Enviromental aircraft systems, Anti-icing aircraft systems, Aircraft electrical systems, Aircraft cabin systems, Avionics, Aircraft Control systems, Aircraft safety systems.

**practical teaching**

Practical teaching is related to prezenting samples, analysis and discusion with students in the fields previously treated theoretically. Hidraulic aircraft systems, Fuel aircraft systems, Pneumatic aircraft systems, Enviromental aircraft systems, Avionics, Control aircraft systems, Electrical aircraft systems, Aircraft safety systems, Anti-icing aircraft systems.

**prerequisite**

Declared by the curiculum of study programe/modul.

**learning resources**

Various written forms from teching.
Various books and papers.

**number of hours**

**total number of hours:** 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
Computational methods in aeronautics

ID: BSc-0568
teaching professor: Симоновић М. Александар
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 4
final exam: written
parent department: aerospace engineering

goals

Introducing students to the basics of computer applications in simulations and computations of aeronautical problems. The subject is organized so that several typical (model) problems are completely solved step-by-step from start to finish.

learning outcomes

By mastering the curriculum a student gains specific skills:
• thorough knowledge and understanding of numerical methods
• ability to use and apply basic numerical methods for solving ODE, finite difference and finite elements methods
• correlation between fundamentals in mathematics, programming, mechanics, fluid mechanics and construction analysis

theoretical teaching

• Determination of geometrical characteristics of sections
• Parameters of compressible flow - Fundamental equations for one-dimensional compressible flow
• Calculation of the flow around a cone (example of solving a problem modeled by ODE)
• Simulation of plane take-off (also example of solving a problem modeled by ODE, application of interpolation methods to aerodynamic characteristics of aircrafts)
• FEM calculation of lattice structures (example of solving sparse systems of equations with many unknowns)

practical teaching

• Determination of geometrical characteristics of sections - using a program for calculating the geometrical characteristics of sections
• Parameters of compressible flow - an interactive program for parameters of compressible flow
• Calculation of the flow around a cone (example of solving a problem modeled by ODE) - computational problem solving, obtained results and analysis
• Simulation of plane take-off (also example of solving a problem modeled by ODE, application of interpolation methods to aerodynamic characteristics of aircrafts) - a program for calculating take-off distance and velocity
• FEM calculation of lattice structures (example of solving sparse systems of equations with many unknowns) - a program for calculating stresses of two-dimensional lattices
prerequisite

There are no necessary conditions for attending the subject.

learning resources

1. Petrovic Z, Stupar S, CFD one, Faculty of Mechanical Engineering, 1992, KPN
2. Additional materials (lecture hand-writings, problem settings, task solving guidelines), DVL
3. 452, Computer laboratory SimLab, IKT/CAH
4. FORTRAN, Computer laboratory SimLab, IKT/PPO

number of hours

total number of hours: 45

active teaching (theoretical)

lectures: 17

active teaching (practical)

auditory exercises: 8
laboratory exercises: 4
calculation tasks: 0
seminar works: 4
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 4
check and assessment of projects: 0
colloquium, with assessment: 3
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 20
calculation tasks: 0
seminar works: 20
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
Design and Aircraft Production Technology

**ID:** BSc-0253  
**teaching professor:** Петровић И. Златко  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** seminar works  
**parent department:** aerospace engineering

**goals**

To introduce students to process of modeling of aircraft components and to teach them to understand and to apply necessary technologies to produce these components. Students are taught to skills which connect typical loads with typical design solutions. Besides theoretical knowledge necessary to model aircraft students will be taught also to use modern design software tool.

**learning outcomes**

Understanding of airplane structure, and relationship between elements. Understanding of aerodynamic, flight mechanic, propulsion influences on aircraft design. Understanding of manufacturing process and surface protection. Mastering modern software tool used to design assemblies and aircraft.

**theoretical teaching**


**practical teaching**

Exercises follow lectures illustrating them with applications. Students are taught to use CATIA design tool. Students get experience with various modules of this software. Modeling of parts, sheet metal parts, and drawing is covered. Students get homework to design several aircraft parts using this package. Solutions are presented to colleges. Discussion of good and weak points of the design took place during presentation.

**prerequisite**

Defined by curricula of study program.

**learning resources**

1. Б. Рашуо, Технологија производње летелица, Машински факултет, Београд, 1995  
2. Lecture slides  
3. Laboratory SimLab  
4. Software CATIA
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 0
consultations: 10
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 10
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 15
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 55
project design: 0
final exam: 30
requirements to take the exam (number of points): 25

references
FEM Analysis

ID: BSc-0544

**teaching professor:** Симоновић М. Александар

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** aerospace engineering

**goals**

Understanding and mastering the process of solving engineering problems using finite elements method and modern software tools. Furthermore, the aim of this course is to develop personal and professional skills of the students along with the development of analysis methodology and solving engineering problems.

**learning outcomes**

After accomplishing the course, a student is capable of working in modern work environments. With learned skills student can implement his theoretical and practical knowledge in engineering practice, achieving a high degree of effectiveness. This knowledge encourages further improvement for students.

**theoretical teaching**


**practical teaching**

Practice: mathematical foundations - numerical methods of analysis - the basics of matrix algebra - the mathematical interpretation of the finite element - solving engineering problems using FEM (linear elements) – solving engineering problems using FEM (surface elements) - solving engineering problems using FEM (volume elements) - a comparative analysis of the results obtained with finite element method and classical methods of calculation - the interpretation of results and verification of analysis results

**prerequisite**

Preferred: Attended and passed courses – Mathematics 1-3, Mechanics 1-3, Shape modeling, Strength of material

**learning resources**

2. Additional materials (written excerpts with the lectures, setting tasks, guidelines for solving the task), DVL
6. 455, Computer Lab – Design in mechanical engineering module, IKT/CAH (in Serbian)
7. CATIA V5 software package, Computer Lab – Design in mechanical engineering module, IKT/CSP (in Serbian)

**number of hours**

**total number of hours:** 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 30  
laboratory exercises: 0  
calculation tasks: 0  
seminar works: 0  
project design: 0  
consultations: 0  
discussion and workshop: 0  
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0  
check and assessment of lab reports: 0  
check and assessment of seminar works: 0  
check and assessment of projects: 0  
colloquium, with assessment: 10  
test, with assessment: 0  
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0  
test/colloquium: 60  
laboratory exercises: 0  
calculation tasks: 0  
seminar works: 0  
project design: 0  
final exam: 40  
requirements to take the exam (number of points): 30

**references**
Fundamentals of aerotechnics

ID: BSc-0630
teaching professor: Петровић Б. Небојша
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written
parent department: aerospace engineering

goals

The aim of this course is to introduce students to basic concepts in the field aerotechnics. The subject is presented in four integrated areas: aerodynamics, structures and construction, plant and equipment. In addition to popularize aviation, the aim of this course is to highlight the role of students in various fields aerotechnics mechanical engineering.

learning outcomes

After passing the subjects the students are expected to understand the basic concepts and problems in the field of aerodynamics, structures, construction, aircraft engines and aircraft equipment. In doing so, it is expected that the student able to recognize and apply these disciplines of aviation technology in other areas.

theoretical teaching

In the theoretical part analyzes the following topics: history of aviation, aircraft types (basic components and their role), the concept of aerodynamic forces, the notion of aerofoil (geometric and aerodynamic characteristics), different aerodynamic aircraft structural scheme: a mathematical model aircraft-core performance, analysis of mass, center of gravity, the notion Centraza; budget based aircraft structures, types of forces acting on the aircraft, the flight envelope, elementary calculations of aircraft parts (motor mount, nose leg); historical overview of aviation design, aviation design types, analysis of the construction costs of aviation; basic elements of stricture wings and fuselage, making Straka fuselage; types of facilities, historical development, basic concepts (traction and thrust force), piston-driven propeller, the impact position driveline, turbo-jet aircraft, rocket-powered aircraft; place and role equipment and systems, installation and basic aircraft systems, encoders, instruments and equipment (Historically the development of constructive solutions), role of computers in design, construction and maintenance.

practical teaching

In the practical part of teaching the short working computational tasks and analyze the concepts and examples of various constructive aerodynamic types solutions (different types of aircraft, vehicles, wind, etc.). Students operate using a virtual workshop on the internet in case they are registered in groups. Students, as part of their group, work of reference for a given aircraft, and the exercises are consulted about the form, scope and content of work. The paper presents representative of the group, in the last week of classes. Planned students excursions one of aviation organizations to familiar the real structures and systems used in aircraft.

prerequisite

without the conditions

learning resources
The work on the case is open a virtual shop on the Internet. MOODLE is used program. Students enrolling in the electronic workshop, a dress for the first time. In the workshop, students can access the professor notes, and additional material that advise the professor. As part of the work on subject is open a virtual workshop on the Internet. MOODLE is used program. Students be registered in the electronic workshop, and be trained for the first class. Using MOODLE students can access the professor notes, and additional material that advise the professor.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 5
seminar works: 0
project design: 10
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 40
final exam: 30
requirements to take the exam (number of points): 30

references
Introduction to engineering simulations

**ID:** BSc-0019  
**teaching professor:** Петровић И. Златко  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** seminar works  
**parent department:** aerospace engineering

**goals**

The students would be introduced to engineering simulations based on continuum mechanics. The students should acquire understanding of well posed problem through definition of boundary and initial conditions applied to certain physical phenomenon which characterize existence and uniqueness of the solution. Adoption of the specific type of additional conditions depending on the type of the problem, as well as selection of appropriate approximation for solution of the model problems would be presented to students. The students should gain skills for individual code development for model equations.

**learning outcomes**

By mastering the curriculum the student will gain sufficient theoretical knowledge necessary to identify the problem type, number and type of boundary conditions in order to define well posed problem which is simulated. The student will be able to identify basic schemes for calculation of problems of certain type. The basic principles of programming for simulation of continuum should be adopted by the student. The structure of simulation software which consist of preprocessing, simulation and visualization should be perceived by the student.

**theoretical teaching**

1. Introduction to engineering simulations in order to familiarize students with typical engineering problems 2. Fundamentals of numerical methods 3. Implementation of numerical methods for solving of engineering problems 4. Theoretical fundamentals for typical problems solving using complementary software tools

**practical teaching**

Exercises consist of three parts: introduction to work on Linux cluster, student registration and login and usage of commands for compilation, source code editing and visualization of the results. The second part of the exercises consist of practical demonstration of the methods presented in theoretical classes, where similar problems to problems for own student work are solved. The third component of the exercises is programming of the mentioned problems in order to complete the cycle of editing, compilation and result visualization process. The students are learned to present there work in general acceptable manner.

**prerequisite**

There aren’t any compulsory conditions for course attendance.

**learning resources**

1. Linux cluster

**number of hours**

total number of hours: 75
active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 20
calculation tasks: 0
seminar works: 5
project design: 0
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 10
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 15
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 55
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references
Introduction to engineering simulations

ID: BSc-0617

teaching professor: Бенгин Ч. Александар

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: seminar works

parent department: aerospace engineering

goals

The students would be introduced to engineering simulations based on continuum mechanics. The students should acquire understanding of well posed problem through definition of boundary and initial conditions applied to certain physical phenomenon which characterize existence and uniqueness of the solution. Adoption of the specific type of additional conditions depending on the type of the problem, as well as selection of appropriate approximation for solution of the model problems would be presented to students. The students should gain skills for individual code development for model equations.

learning outcomes

By mastering the curriculum the student will gain sufficient theoretical knowledge necessary to identify the problem type, number and type of boundary conditions in order to define well posed problem which is simulated. The student will be able to identify basic schemes for calculation of problems of certain type. The basic principles of programming for simulation of continuum should be adopted by the student. The structure of simulation software which consist of preprocessing, simulation and visualization should be perceived by the student.

theoretical teaching

1. Introduction to engineering simulations in order to familiarize students with typical engineering problems 2. Fundamentals of numerical methods 3. Implementation of numerical methods for solving of engineering problems 4. Theoretical fundamentals for typical problems solving using complementary software tools

practical teaching

Exercises consist of three parts: introduction to work on Linux cluster, student registration and login and usage of commands for compilation, source code editing and visualization of the results. The second part of the exercises consist of practical demonstration of the methods presented in theoretical classes, where similar problems to problems for own student work are solved. The third component of the exercises is programming of the mentioned problems in order to complete the cycle of editing, compilation and result visualization process. The students are learned to present there work in general acceptable manner.

prerequisite

There aren’t any compulsory conditions for course attendance.

learning resources

1. Linux cluster

number of hours

total number of hours: 75
active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 20
calculation tasks: 0
seminar works: 5
project design: 0
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 10
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 15
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 55
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references
Light and Composite Aircraft Structures

ID: BSc-0635

teaching professor: Ступар Н. Слободан

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: aerospace engineering

goals

The goal of this course is to acquaint students with the properties of composite materials used for making aircraft structures, composite manufacturing technologies as well as the specifics of their implementation and exploitation in aeronautics.

learning outcomes

After completing the course, a student is familiar with the philosophy of design, manufacturing technologies and specifics of protection, exploitation and maintenance of composite aircraft structures. Acquired theoretical knowledge and practical skills, students can effectively apply in the construction of composite aircraft parts and their analysis. Within practical training students learn the basics of modern software packages intended for the modeling and calculation of composite parts.

theoretical teaching

- Overview of composite materials application in military and civil aviation
- Mechanics of Composite Materials
- Design of composite parts
- Production of composite parts - the integration of production processes and CAD
- Machining of composite structures; joining of composite parts.
- Damage of composite structures; classification of damage and methods of repairs
- Testing and certification of composite structures
- Trends and future applications of composite structures. New technologies of production.

practical teaching

Within lab exercises, the material exposed during theoretical lectures is expanded with concrete examples. Students gain experience in the use of modern engineering software, with an emphasis on shape modeling, material properties modeling and finite element analysis, which they can later use for solving real engineering problems.

prerequisite

No obligatory prerequisites. Suggested attended and passed courses: Mechanics 1-3, Material strength, Introduction to engineering simulations.

learning resources

1. Lecture materials (written excerpts of the lectures, problem formulations, guidelines for solving the problems), DVL
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 10
seminar works: 0
project design: 10
consultations: 10
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 10
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 15
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 55
final exam: 30
requirements to take the exam (number of points): 25

references
Light and Composite Structures

ID: BSc-0214  
teaching professor: Петровић И. Златко  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 6  
final exam: project design  
parent department: aerospace engineering

goals

The goal of course is to acquaint students with the properties of composite materials used for making aircraft structures, composite manufacturing technologies as well as the specifics of their implementation and exploitation in aeronautics.

learning outcomes

After completing the course, a student is familiar with the philosophy of design, manufacturing technologies and specifics of protection, exploitation and maintenance of composite aircraft structures. Acquired theoretical knowledge and practical skills, students can effectively apply in the construction of composite aircraft parts and their analysis. Within practical training students learn the basics of modern software packages intended for the modelling and calculation of composite parts.

theoretical teaching

- Overview of composite materials application in military and civil aviation  
- Mechanics of Composite Materials  
- Design of composite parts  
- Production of composite parts - the integration of production processes and CAD  
- Machining of composite structures; joining of composite parts.  
- Damage of composite structures; classification of damage and methods of repairs  
- Testing and certification of composite structures  
- Trends and future applications of composite structures. New technologies of production.

practical teaching

Within lab exercises, the material exposed during theoretical lectures is expanded with concrete examples. Students gain experience in the use of modern engineering software, with an emphasis on shape modeling, material properties modeling and finite element analysis, which they can later use for solving real engineering problems.

prerequisite

No obligatory prerequisites.  
Suggested attended and passed courses: Mechanics 1-3, Material strenght, Introduction to engineering simulations.

learning resources

1. Lecture materials (written excerpts of the lectures, problem formulations, guidelines for solving the problems), DVL

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 10
seminar works: 0
project design: 10
consultations: 10
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 10
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 15
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 55
final exam: 30
requirements to take the exam (number of points): 25

**references**
Mechanics of Flight

ID: BSc-0648

**teaching professor:** Рашуо П. Бошко

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** seminar works

**parent department:** aerospace engineering

**goals**

Introduce students to the basics of movement of aircraft in atmospheric and space flight. Students will learn the basis of performance, stability, controllability and manoeuvrability of aircraft.

**learning outcomes**

Completed the planned curriculum students obtain sufficient theoretical and practical knowledge to be able to self-performance can be evaluated possibilities of modern aircraft and the limitations of flight options that resulting from it. In this course students will receive full sublimation and verification of previously acquired knowledge and skills that they get into the aviation module from aerodynamic case.

**theoretical teaching**


**practical teaching**


**prerequisite**

No conditions

**learning resources**

A. C. KERMODE, Mechanics of Flight, 11th EDITION, Prentice Hill, England, 2006., include necessary material for lectures, exercises, assignments, projects and term papers. Require additional materials (handouts, setting assignments, term papers, etc..) Are given at the web site or reproduced on paper. Large-scale electronic materials can be made available to students in direct contact.

**number of hours**

38
total number of hours: 75

active teaching (theoretical)
lectures: 30

active teaching (practical)
auditory exercises: 10
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 0
consultations: 10
discussion and workshop: 5
research: 0

knowledge checks
check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 5
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)
feedback during course study: 15
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 45
project design: 0
final exam: 40
requirements to take the exam (number of points): 60

references
professional practice B - AVIATION

ID: BSc-0398
teaching professor: Петровић Б. Небојша
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 1
final exam: seminar works
parent department: aerospace engineering

goals

The goal of this course is to introduce students to the process of design and construction aircraft technology, installation of aviation equipment and systems, process manufacturing aircraft components, methods of aircraft ground and flight testing; introduction to the factories technological production lines, quality control, safety systems organization, maintenance process.

learning outcomes

Successful completion of of course students are introduced to: corresponding types of aircraft, analysis methods and procedures of design and construction of aircraft, aircraft technical regulations of safety and maintenance (JAR i FAR) etc.

theoretical teaching

Introduction. The role and importance of professional practice in the education of engineers of aviation. The basic principles of design and construction of aircraft; aerodynamics, design, structure, aircraft equipment, systems and propulsion. Basic methods of aircraft testing. Measuring and testing equipment. Safety and aircraft maintenance. Instructions for keeping a diary.

practical teaching

Tours and visits to factories • project organizations in the field of aviation, • organizations that produce components and equipment in the field of aviation • maintenance organizations, organizations involved in testing • organizations involved in the organization of air traffic, organizations involved in education of aviation personnel, visits to aviation meetings. In an independent work, students completing the practice technical report.

prerequisite

There are no attendance requirements for professional practice

learning resources

number of hours

total number of hours: 46

active teaching (theoretical)

lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 0

references
Structural Analysis of Flying Vehicles

ID: BSc-0541

Teaching Professor: Динуловић Р. Мирко

Level of Studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

Final exam: seminar works

Parent Department: aerospace engineering

Goals

1. Introduction to problems and modern solution methods in stress analysis related to aircraft structures and their implementation in solving real structural problems.
2. Introduction to experimental stress analysis of aircraft structures.
3. Introduction to thin-walled structures and composite materials.
4. Introduction to computer modeling and simulation of aircraft structures.

Learning Outcomes

1. Mastering basic theoretical knowledge in structural analysis.
2. Application of acquired knowledge in solving real-world problems.
3. Understanding basic aircraft design principles.
4. Understanding modern approach in solving structural problems in aircraft airframe design.

Theoretical Teaching

In the theoretical part, following topics are covered: Irregular loads, load coefficient, flight envelope, envelope for symmetric flight cases, gust loads, unsymmetric loading conditions, landing gear loads, engine mount loads and stress analysis, wing skin, skin buckling, normal and shear stress calculation, effective width, wing stress analysis, wing spar analysis, fuselage rib connection analysis, design solutions, delta wing stress calculation, fuselage stress strain calculation methods, pressurized cabin calculation, stress analysis in the vicinity of openings, fuselage rib calculation, finite element method applied to airframe structural analysis, structure idealization, composite material stress calculation, static and dynamic testing and testing fixtures design, apparatus and techniques in experimental stress analysis.

Practical Teaching

During the practical part of the course, theories related to aircraft stress analysis are applied to real problems. Numerical examples are analyzed. Practical student work is realized through mandatory exercises and design project realization using computer software for modeling and analysis. Professor lecture notes, solved past exam papers are at student’s disposition. Practical part of the course also includes visit to the VTI technical institute.

Prerequisite

Recommended: Theory of elasticity, Resistance of Materials

Learning Resources

Lecture notes in e-format, media films and computer simulation models, internet resources

Number of Hours

Total number of hours: 75
active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 5
seminar works: 0
project design: 10
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 5
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 0
calculation tasks: 10
seminar works: 0
project design: 20
final exam: 40
requirements to take the exam (number of points): 40

references

Structural and Stress analysis, T.H.G Megson
Theory of Elasticity

ID: BSc-0539

teaching professor: Динуловић Р. Мирко

teaching professor: Динуловић Р. Мирко

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: aerospace engineering

goals

1. Introduction to stress analysis related to aircraft structures and its application to practical airframe sizing and stress analysis.
2. Introduction to experimental stress-strain analysis of airframe structures
3. Introduction to thin-walled constructions and composite material constructions
4. Introduction to modern numerical stress analysis applied to aircraft constructions, analysis and performance

learning outcomes

1. Mastering theoretical knowledge of aircraft structural analysis
2. Application of theory to solve practical problems related to aircraft stress analysis
3. Understanding basic aircraft design solutions.
4. Knowledge of modern methodology approach to solve problems related to design and stress analysis of aircraft components

theoretical teaching


practical teaching

During practical part of the course covered topics in theoretical part are demonstrated in practice. Typical practical problems are analyzed through numerical examples. Students are required to complete practical project work using computer modeling and analysis. All required material is available in the form of lecture notes, books and past exams and tests.

prerequisite

Mathematics, Resistance of materials

learning resources

Computing Laboratory for Theory of elasticity and Aeroelasticity

number of hours
total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 5
seminar works: 0
project design: 10
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 0
calculation tasks: 10
seminar works: 0
project design: 20
final exam: 40
requirements to take the exam (number of points): 21

references

Structural and Stress analysis, T.H.G Megson
Elasticity, Chou and Pagano
Windturbines

ID: BSc-0069

**teaching professor:** Ступар Н. Слободан

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** oral

**parent department:** aerospace engineering

**goals**

Throughout this course student will learn about the principles, components and design of wind turbines, as well as regulation and dynamic balancing of the system. Acquiring the knowledge necessary for wind turbine blade design based on the aerodynamic and structural criteria, performance computation (power, coefficient of power, torque, aerodynamic characteristics of blades), calculation based on similarity theory and the topology definition of wind energy systems is the main aim of the subject.

**learning outcomes**

Mastering the curriculum the student receives the following subject-specific skills:

- thorough knowledge and understanding of different concepts of wind turbines and design methods;
- skills needed for wind turbine and its parts selection according to given operating conditions using scientific methods and procedures;
- integration of fundamental knowledge in mathematics, programming, mechanics and fluid mechanics and application to design and calculations of wind turbines;

**theoretical teaching**

- Introduction to wind energy; - Historical overview of wind turbines;
- Components of wind turbines – analysis and design of rudimentary assemblies;
- Wind characteristics
- Dimensioning of wind turbine blades – Betz theory, aerodynamic forces on rotating blades, the losses;
- Calculation of characteristics;
- Structure and blade load;
- wind turbines similarity theory- application and limitations;
- pumps driven by wind- possibilities of application, types, coupling of wind turbines and pumps, sizing;
- wind turbine electrical system- main concepts, types of generators, accumulation of electrical energy, systems connected to public grid, losses in energy transmission system;
- Regulation of wind turbines;
- The dynamics of wind turbines - the oscillations in the system, modeling of oscillations;
- Off-shore wind turbines - requirements, types of off-shore wind turbines, foundations and structure of the types of off-shore wind farms, maintenance
- The construction of wind turbines

**practical teaching**

- Presentation of various wind turbine designs
- Basic parts of the system
- Devices for the wind speed measurements - anemometers
- Dimensioning of the blades - a numerical simulation of the flow around airfoils and blades
dimensioning
- Performance calculations - the development and application of existing software for the calculation of characteristics of wind turbines
- Analysis of the stress - strain state of turbine rotor blades
- Static testing of blades
- Dynamic testing of blades
- Configuration of wind energy systems

prerequisite

There are not any compulsory conditions for course attendance.

learning resources

1. Pesic S., Wind energy - Aerodynamics wind energy system with a horizontal axis rotor, Faculty of Mechanical Engineering, 1994., KDA (in serbian)
2. Petrović Ž. Stupar S., Computer design, Faculty of Mechanical Engineering, 1992, KPN (in serbian)
3. Additional materials (written performed with the lectures, setting tasks, guidelines for solving the task), DVL
4. 452, Computer Laboratory SimLab, ICT / CAH / KLR
5. FORTRAN, Computer Laboratory SimLab, ICT / PPO

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 12
calculation tasks: 0
seminar works: 8
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 2
check and assessment of seminar works: 4
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 15
laboratory exercises: 15
calculation tasks: 15
seminar works: 15
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
agricultural engineering

Basics of Agricultural Machines and Equipment
Biosystem Engineering
Drying and Hygrothermal processes
Machines and Equipment for Food processing and Production
Professional practice B - IBS
Renewable and secondary resources
Theory of Agricultural Machines and Equipment
Basics of Agricultural Machines and Equipment

ID: BSc-0507  
teaching professor: Вељић М. Милан  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 6  
final exam: written+oral  
parent department: agricultural engineering

goals

1. Finding that a multidisciplinary approach can achieve optimal results in the design, maintenance and operation of agricultural machinery, appliances and equipment. 2. Master the theoretical foundations of working groups, aggregates terminal tractor agricultural machinery integrated systems of agricultural machinery. 3. Acquire practical knowledge and skills in solving practical engineering problems of agricultural machinery and equipment.

learning outcomes

1. Fundamental knowledge of theories of agricultural machinery. 2. Synthesis theory of driving skills, connection and integrated system of agricultural machinery. 3. Skills of application of these skills in the field of design and operation of agricultural machinery. 4. Basic practical knowledge in the production of agricultural machinery, appliances and equipment.

theoretical teaching

1) Agricultural machinery - introduction, 2) Theory of plant agricultural machine-farm tractors, 3) Theory of trailers farm machinery, the concept of traction and performance 4) The theory of agricultural units - integrated propulsion and associated agricultural machines, 5) operating elements agricultural machinery. Support structure. 6) Automation and process control of agricultural machines, 7) The concept of machines for soil cultivation, sowing, planting, fertilization and chemical protection 8) Basic assumptions and characteristics of machinery for the collection and sorting of agricultural products. 9) Maintenance and operation of agricultural machinery.

practical teaching

1) Laboratory Exercise: Introduction to measuring instruments and measurement systems for agricultural machinery—Measurement of power, number of revolutions and torque on the PTO shaft of tractor, 2) Analysis and presentation of the kinematics and dynamics of the tractor and the working of agricultural machines for soil cultivation, sowing and planting, crop protection and harvesting of agricultural products, 3) A conceptual design in the field of tractors and agricultural machinery.

prerequisite

Attended first year

learning resources

Veljić M., Markovic D., Technological processes of mechanized agriculture, MF BGD, 1997., Lectures in electronic form, Instructions for making arithmetic problems and laboratory exercises, Prominent piece of the project
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 25

active teaching (practical)

auditory exercises: 10
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 10
consultations: 5
discussion and workshop: 5
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 2
colloquium, with assessment: 2
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 30
final exam: 30
requirements to take the exam (number of points): 50

references

Martinov M., Markovic D., Machinery and tools for soil cultivation, the first part, FTN, Novi Sad, 2002.
Biosystem Engineering

**ID:** BSc-0538  
**teaching professor:** Марковић Д. Драган  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** oral  
**parent department:** agricultural engineering

**goals**

1. Master the theoretical foundations of engineering in food production; 2. Introduction to the basic stages of the life cycle of machinery/equipment for food production; 3. Getting to know limitations and specific engineering in food production; 4. Introduction to basic principles of engineering in food production; 5. Acquire practical skills in analyzing the set of engineering problems and its solving multidisciplinary approach.

**learning outcomes**

1) A thorough understanding of basic principles of engineering, manufacturing and food processing, 2) Basic knowledge on life cycle analysis machinery/equipment manufacturing and food processing, 3) Analysis and synthesis of design solutions and acquiring methods of optimization; 4) Connect the basic engineering knowledge and achievement synergetic effect, 5) Introduction to development trends in the development and manufacture of machinery/equipment manufacturing and food processing.

**theoretical teaching**

1) The life cycle of machinery / equipment manufacturing and food processing - research and development, manufacture, use and post-use of machinery / equipment manufacturing and food processing, 2) The life cycle of food in the food chain and the interaction of food and equipment, interdependencies and impacts 4) The information in the development of machinery / equipment manufacturing and food processing, 5) Factors that influence the development of machinery / equipment, 6) Optimization of development, 7) Development process, the duration of development and diversity of modification and development of machinery / equipment for manufacturing and processing food, 8) Product requirements and prerequisites for the production of equipment for food, 9) Distribution, installation and servicing of machinery / equipment for food production, 10) Mining machinery / equipment in real conditions, 11) Post-usable period of machinery / equipment, 12) Feedback to the development, 13) Engineers and engineering of food.

**practical teaching**

Seminar papers - Research and development of machinery / equipment for food production, production machinery / equipment for food production, the use of machinery manufacturing and food processing, post-use of machinery / equipment manufacturing and food processing. The project - development project life-cycle machinery / equipment manufacturing and food processing.

**prerequisite**

**learning resources**

Markovic D., Transportation in agriculture, MF in Belgrade, Belgrade, 1997. Lectures in electronic format, with lecture slides (handouts),
Instructions for creating term papers, instructions for creating projects, laws, standards and regulations for industrial production and food processing

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 20

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 20
consultations: 5
discussion and workshop: 5
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 3
check and assessment of projects: 7
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 50
final exam: 30
requirements to take the exam (number of points): 50

**references**

Todorovic S., Engineering Maintenance Technical Systems, School of Medicine, Belgrade, 1993.
Nemacka Getredeerte-sauber, sicher, schnell, DLG-Verlags, GmbH, Frankfurt am Main, 2005.
Profitability use GPS tracking devices and switching walked in agriculture of Vojvodina, University of Novi Sad, 2008.
Drying and Hygrothermal processes

ID: BSc-0461

teaching professor: Топић М. Радивоје

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: agricultural engineering

goals

Understanding the theoretical foundations and engineering data from field and hygrothermal drying process, which engineers need for the rational use of energy, design of appropriate solutions and efficient implementation of processes and work units and systems, including the development of creative abilities and mastery of practical skills for specific job performance.

learning outcomes

Qualifications of the theoretical and practical knowledge necessary to independently solve concrete theoretical and engineering tasks in a given area, which involves applying knowledge in practice, solving practical problems using scientific methods and procedures and monitoring and implementation of innovations in the profession.

theoretical teaching

1.0. Physical and chemical basis of the drying process: Wet gas (air); Wet materials; Statics of the drying process. 2.0. The theory of energy transfer and moisture transfer in the drying process; Drying process kinetics; Coupled process of heat and mass transfer in the drying process. 3.0. Fundamentals of drying technique: The basic method of isolating moisture: The basic ways of thermal drying. 4.0. Snapshot of drying plant and the basis of engineering calculations: Classification and a brief overview of the plant for drying; Basic calculations of a drying plant. 5.0. Thermal physics of manufacturing facilities. 6.0. Application of heat in the farmhouses and cattle complexes: The microclimate in facilities for livestock and poultry. 7.0. Facilities with protected space. 8.0. Technological base of products storage, storage conditions, storage types and storage methods. 9.0. Use of low temperatures in agricultural production: Physical essence and cooling methods. 10.0. The economy of thermo energy resources and thermo-technical indicators: The use of renewable energy sources; Use of secondary energy resources; Improving ventilation system design and increased thermal resistance of the walls.

practical teaching

Practical work: Preparation of seminar papers from some of the theoretical wholes, in order to get familiar with the existing solutions, their characteristics and monitoring developments in the area; Development of computational tasks. Labs: 1.0. Determination of moisture content of wet materials. 2.0. Determination of physical and mechanical properties of biological materials (porosity, friction angle).

prerequisite

Defined curriculum study program modules.

learning resources


**number of hours**

Total number of hours: 75

**active teaching (theoretical)**

Lectures: 30

**active teaching (practical)**

Auditory exercises: 0
Laboratory exercises: 5
Calculation tasks: 10
Seminar works: 10
Project design: 0
Consultations: 0
Discussion and workshop: 0
Research: 5

**knowledge checks**

Check and assessment of calculation tasks: 3
Check and assessment of lab reports: 2
Check and assessment of seminar works: 3
Check and assessment of projects: 0
Colloquium, with assessment: 0
Test, with assessment: 2
Final exam: 5

**assessment of knowledge (maximum number of points - 100)**

Feedback during course study: 10
Test/colloquium: 30
Laboratory exercises: 10
Calculation tasks: 10
Seminar works: 10
Project design: 0
Final exam: 30
Requirements to take the exam (number of points): 35

**references**

Lykov V. M (1970), Dying in the chemical industry, the publishing house, "Chemistry", Moscow.
Machines and Equipment for Food processing and Production

ID: BSc-0079

teaching professor: Марковић Д. Драган

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: project design

parent department: agricultural engineering

goals

1. Master the theoretical foundations of machinery and equipment manufacturing and food processing; 2 Mastering the basic technological processes in food production and processing; 3 Introduction to basic principles of machine design, equipment and technological lines for manufacturing and food processing; 4 Acquire practical skills in analyzing the set of engineering problems and its solution multidisciplinary approach.

learning outcomes

1) A fundamental knowledge base of bio-technical systems engineering, production technology, the principles of machines and equipment for manufacturing and food processing, 2) Theoretical knowledge from theory and construction of machine-harvesting combines and equipment for processing into final products in the food, 3 ) Analysis and synthesis of design solutions for new technologies, machinery, equipment and technological lines, 4) Operation and maintenance of machinery and equipment, 5) acquisition of practical skills and application of acquired knowledge into practice.

theoretical teaching

1) Fundamentals of bio-engineering systems, manufacturing technology and technological operations, principles of operation of machinery and equipment manufacturing and food processing, 2) Theory of the structure: the collection of machinery for agricultural products-harvesters, equipment shipping, handling and external transport of harvested agricultural products to the warehouse and processing factory, product preparation equipment reception, cleaning, sizing, sorting, pneumatic, hydraulic and mechanical transport and processing of the application of new technologies in a variety of final products in the food industry, 3) Analysis and synthesis of design solutions for new technologies, machines, equipment and technological lines for production and processing of agricultural products: production lines for the collection and processing of fruit, production lines for industrial production and processing of vegetables, seeds, grains, products of animal origin, 4) Introducing new technologies and development trends of design, exploitation and maintenance of machinery and equipment manufacturing and food processing;

practical teaching

Seminars:
1. Analysis of technology, machinery and equipment for production and processing of fruits,
2. Analysis of technology, machinery and equipment for production and processing of vegetables,
3. Analysis of technology, machinery and equipment for production and processing of grains and seeds,
4. Analysis of technology, machinery and equipment for production and processing of meat and dairy products.

Project:
The project conceptual design of machinery, equipment and technological lines for food
production and processing, with the necessary calculations, defined through the topics above mentioned seminar.

**prerequisite**

Attended courses of previous years of study and all the conditions defined curriculum of study program/module

**learning resources**

2. Lectures in electronic format, with lecture slides (handouts) with instructions to create term papers and projects

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 20
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 3
check and assessment of projects: 7
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 50
final exam: 30
requirements to take the exam (number of points): 50

**references**
Zlatković B. The technology of processing and storage of fruit, published by University of Belgrade, Faculty of Agriculture 2002nd
Moser E.:Verfahrenstechnik Intensivkulturen,Verlag Paul Parey,Univerzitet Hohenheim,2005.,Nemacka
Professional practice B - IBS

ID: BSc-0500
teaching professor: Марковић Д. Драган
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 1
final exam: seminar works
parent department: agricultural engineering

goals

Practical experience and students living in agricultural combines and factories of agricultural machinery and equipment, where the student will realize his professional career. Identifying the basic functions of the business system in the field of design, development and production, as well as the role and tasks of agricultural mechanical engineering in such a business system.

learning outcomes

Students obtain practical experience on the way is the organization and functioning of the environment in which they will apply their knowledge in their future professional career. Student identifies models of communication with colleagues and business communications trends. Student identifies the core processes in the design, manufacture, maintenance of agricultural machinery and equipment in the context of his future professional competence. Establish the personal contacts and relationships that will be able to use at school or entering into future employment.

theoretical teaching

Selected topics through practical activities.

practical teaching

Practical work involves working in organizations that perform various activities in connection with the design and construction of agricultural machinery and equipment. Selection of thematic areas and industrial and research organizations is carried out in consultation with the concerned teacher. In principle a student can perform in practice: production companies, design and consultancy offices, organizations dealing with maintenance of mechanical equipment. The practice can be carried out abroad. During practice, students need to keep a diary in which to enter a description of operations performed, the conclusions and observations. Once completed practice must make a report to defend the subject teacher. The report is submitted in the form of the paper.

prerequisite

It is recommended for students from IBS modules

learning resources

Laboratory and IT equipment

number of hours

total number of hours: 46

active teaching (theoretical)
lectures: 0

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 50

**references**

Renewable and secondary resources

ID: BSc-0460
teaching professor: Топић М. Радивоје
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: agricultural engineering

goals

Understanding the theoretical foundations and engineering data which engineers need for the rational use of energy, design of appropriate solutions and efficient implementation of processes and work units and systems for useful valorisation of renewable and secondary energy sources, including the development of creative abilities and mastery of practical skills for specific job performance.

learning outcomes

Qualifications of the theoretical and practical knowledge necessary to independently solve concrete theoretical and engineering tasks in a useful valorisation of renewable and secondary energy sources, including the application of knowledge in practice, solving practical problems using scientific methods and procedures and monitoring and implementation of innovations in the profession.

theoretical teaching

1.0. General information: The global aspect of energy; Energy and forms of energy; Renewable energy sources 2.0. Solar energy: Solar radiation; Solar energy collectors. 3.0. Wind power: Wind power and its importance, speed and wind energy potential; Wind turbines and their characteristics; Division of wind turbines by place of performance and power values, Advantages and disadvantages of different types of wind turbines. 4.0. Biogas: Anaerobic fermentation; Components of biogas plants, processes and characteristics: Types of digester systems for production of biogas. 5.0. Biomass: What is biomass; Energy from biomass; Methods of obtaining energy from biomass; Reasons and benefits of using biomass; Display concept solutions for high temperature drying of sawdust. 6.0. Heat pumps: Operating principles and characteristics of heat pumps: Thermodynamic properties cycles of heat pumps; Heat sources and purpose of heat pumps; Heat pump systems for use of different energy sources. 7.0. The energy from the environment; Geothermal energy; Hydrogen energy; Fuel cells. 8.0. Using the energy of the gravitational field; Use of tide energy, using energy waves. 9.0. The use of secondary energy resources.

practical teaching

Simulation of solar energy system. Examination of the indirect solar drying on the laboratory facility at the Institute for Agricultural Mechanical Engineering Department in order to define the kinetics of drying of biological materials, which involves measuring the mass and temperature of samples of material at certain moments, as well as measuring the intensity of solar radiation and the parameters of drying agents, typical display solution and calculations. They are made to define calculations and dimensioning of characteristic solutions of some of the theoretical whole. Visits to facilities in order to get familiar with the derived solutions for use of renewable energy sources (heat pumps, windmills, solar power, biomass useful valorisation solutions, etc. ..

prerequisite
defined curriculum of study program / module.

learning resources

2. Topic R. Jelena, (2005), technologies and systems for using solar energy, thesis, Belgrade,
3. Topic M. Radivoje, Renewable and secondary resources (Handouts for lecture). Example of reports on laboratory exercises. Various directions and standars.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 5
calculation tasks: 12
seminar works: 8
project design: 0
consultations: 0
discussion and workshop: 0
research: 5

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 2
check and assessment of seminar works: 5
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 3
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 10
laboratory exercises: 20
calculation tasks: 0
seminar works: 30
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references
Фатеев М. Е., (1946), Wind turbines, State energy publisher, Leningrad.
Knap V., Kulišić P., (1985), New sources of energy, School Book, Zagreb
Đulbić M., (1986), Biogas, Technical books, Belgrade
Theory of Agricultural Machines and Equipment

ID: BSc-0558

**teaching professor:** Марковић Д. Драган

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** agricultural engineering

**goals**

1. Finding that a multidisciplinary approach can achieve optimal results in the design, maintenance and operation of agricultural machinery, appliances and equipment. 2. Master the theoretical foundations of working groups, aggregates terminal tractor agricultural machinery integrated systems of agricultural machinery. 3. Acquire practical knowledge and skills in solving practical engineering problems of agricultural machinery and equipment.

**learning outcomes**

1. Fundamental knowledge of theories of agricultural machinery. 2. Synthesis theory of driving skills, connection and integrated system of agricultural machinery. 3. Skills of application of these skills in the field of design and operation of agricultural machinery. 4. Basic practical knowledge in the production of agricultural machinery, appliances and equipment.

**theoretical teaching**

1) Agricultural machinery - introduction, 2) Theory of plant agricultural machine-farm tractors, 3) Theory of trailers farm machinery, the concept of traction and performance 4) The theory of agricultural units - integrated propulsion and associated agricultural machines, 5) operating elements agricultural machinery. Support structure. 6) Automation and process control of agricultural machines, 7) The concept of machines for soil cultivation, sowing, planting, fertilization and chemical protection 8) Basic assumptions and characteristics of machinery for the collection and sorting of agricultural products. 9) Maintenance and operation of agricultural machinery.

**practical teaching**

1) Laboratory Exercise: Introduction to measuring instruments and measurement systems for agricultural machinery-Measurement of power, number of revolutions and torque on the PTO shaft of tractor, 2) Analysis and presentation of the kinematics and dynamics of the tractor and the working of agricultural machines for soil cultivation, sowing and planting, crop protection and harvesting of agricultural products, 3) A conceptual design in the field of tractors and agricultural machinery.

**prerequisite**

Attended first year

**learning resources**

Veljić M., Markovic D., Technological processes of mechanized agriculture, MF BGD, 1997., Lectures in electronic form, Instructions for making arithmetic problems and laboratory exercises, Prominent piece of the project
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 25

active teaching (practical)

auditory exercises: 10
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 10
consultations: 5
discussion and workshop: 5
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 2
colloquium, with assessment: 2
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 30
final exam: 30
requirements to take the exam (number of points): 50

references

Martinov M., Markovic D., Machinery and tools for soil cultivation, the first part, FTN, Novi Sad, 2002.
control engineering

Automation Systems Programming
Computer Control Systems
Control system design
Control Systems
Digital systems
Fundamentals of biomedical engineering
Fundamentals of optics, optical aids and devices
Human Anatomy and Physiology Systems
INTRODUCTION TO AUTOMATIC CONTROL
Process modeling
Professional Practice
Professional practice B - CS
Student practice B - BSc
Systems of Control
Automation Systems Programming

ID: BSc-0590
teaching professor: Јовановић Ж. Радиша
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written
parent department: control engineering

goals

-Introduction to the basic applications of digital computers in automatic control.
-Candidate will be familiar with basic statements of programming language C and programming package MATLAB.
-Candidate will be able to make control software in programming language C.
-This subject introduce candidate with the basic knowledge of programming package MATLAB and its applications in automatic control.

learning outcomes

• Acquiring basic knowledge in programming language C.
• Acquiring basic knowledge in programming package MATLAB.
• Introducing and using methods for analysis and synthesis of control systems by mentioned programming packages.

theoretical teaching


practical teaching

PL:
Examples are in coordinatin with theory: making programs in programming language C and in MATLAB. Examples are from automatic control practice. Realization of various control algorithms, acquisition of data from various peripheral devices. Application of PC computer as digital controller. Control toolbox of programming package MATLAB, and its application in solving various tasks from automatic control. Training is realized in computer laboratory with experimental proof.

prerequisite

Defined by curriculum of the study programme.

learning resources
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references

Computer Control Systems

ID: BSc-0581

teaching professor: Рибар Б. Зоран

level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written
parent department: control engineering

goals

-This subject introduce candidate with basic principles of computer control systems. Also the candidate will be qualified to implement and verify presented theory to real computer control systems.
-Candidate will be familiar with some metodologies for selecting components of various computer control systema.
-Candidate will be familiar with real systems functionality as well as tuning of computer control systems.

learning outcomes

-Introduction with basic principles of computer control systems that is necessary to modern engineer.
-Introduction and use of various methods for control control systems analysis and synthesis.
-Development of analythical and/or experimental methods of testing basic dynamic and static characteristics of control components and computer control systems.

theoretical teaching


practical teaching


prerequisite

Basic principles of thermodynamics, fluid mechanics and physics.

learning resources

- Computer control electrohydraulic servosystem, Control systems laboratory.
- Computer control electropneumatic servosystem, Control systems laboratory.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 22
laboratory exercises: 8
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 20
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
Control system design

ID: BSc-0260
teaching professor: Дебељковић Љ. Драгутин
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: control engineering

goals

Student to be familiar with basic demands in control system design (synthesis) introducing the
basic facts about essential system characteristics working in steady state or in transient
process.
To be informed with wide spectrum of different control design methods and approaches within
the contemporary real control, mostly feedback automatic control systems

learning outcomes

To be familiar, to accept and be capable to use some of offered methods in control system
design and to be learned to implement them on every particular problem from the class of
systems that have been treated within the course.
It is expected that one should be capable to apply some of particular control design methods in
real systems operating time and to implement them on real objects and processes mostly for
particular class of linear feedback control systems.

theoretical teaching

System analysis and synthesis. Criteria for evaluation of systems performance. Demands under
Synthesis of particular class of feedback control systems.

practical teaching

Steady state systems characteristics. Dynamic response and its characteristics. Some criteria in
time domain. Some criteria in frequency domain. Hale-s chart and Nicholas diagram. Complex
plane. Parameter plane control system design methods. Structural design. Bodes diagrams.
Root locus design. Controller matching. Series compensator design. Integral criteria in control
system design. System optimization - elementary approach based on parameter plane methods.
Control design of particular classes of control systems.

prerequisite

There are no any restrictions upon this subject.
It is necessary to attend the course of Automatic control, simultaneously.

learning resources

D.Lj.Debeļjković, B.R.Milojković, “Linear System Design”, Faculty of Mechanical Engineering,

D.Lj.Debeļjković, “Linear System Design - Problems and Exercises”, Faculty of Mechanical

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 18
laboratory exercises: 0
calculation tasks: 0
seminar works: 6
project design: 6
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 2
check and assessment of projects: 4
colloquium, with assessment: 0
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 20
project design: 10
final exam: 30
requirements to take the exam (number of points): 50

references

Control Systems

ID: BSc-0068
teaching professor: Рибар Б. Зоран
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: control engineering

goals

-This subject introduce candidate with basic principles of control systems. Also the candidate will be qualified to implement and verify presented theory to real control systems.
-Candidate will be familiar with some metodologies for selecting components of various control systena.
-Candidate will be familiar with real systems functionality as well as tuning of control systems.

learning outcomes

-Introduction with basic principles of control systems that is necessary to modern engineer.
-Introduction and use of various methods for control systems analysis and synthesis.
-Development of analytical and/or experimental methods of testing basic dynamic and static characteristics of control components and control systems.

theoretical teaching


practical teaching

-Examples of control systems. Pneumatic amplifiers, hydraulic amplifiers: with nozzle and orifices, flapper nozzle, with pistons. Electronic operational amplifiers. Numeric examples. Motion, pressure, flow, level and temperature transducers. Pneumoelectric, hydroelectric and electric motors and actuators.

Electric motors and frequency converters. Hydraulic cylinder with spool valve. Statical characteristics determination.

prerequisite

Basic principles of thermodynamics, fluid mechanics and physics.
learning resources


- Electrohydraulic servosystem, Control systems laboratory.

- Electropneumatic servosystem, Control systems laboratory.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 22
laboratory exercises: 8
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 50

references

Digital systems

ID: BSc-0595
teaching professor: Бучевац М. Зоран
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written
parent department: control engineering

goals

• Introducing with: number systems, Boolean algebra and binary logic, logic functions as well mastery of their usage and manipulation.
• Mastering of: various types of logic circuits-LC and methods for their analysis and design.
• Mastering of handling with integrated digital circuits and oscilloscope.

learning outcomes

• Proper understanding of the nature of digital computers and processes inside them.
• Manipulating digital computers in hardware and software sense as a part of a digital control systems (DCS).
• Using the methods of analysis and synthesis of LC.
• Solving of computational nature problems related to the analysis and synthesis of LC, in "off line" mode, by means of digital computers.
• Analysis and design of real physical LC.

theoretical teaching

• Number systems: definitions; conversion; arithmetic; complements; codes
• Boolean algebra and binary logic: definitions
• Logic functions: definition, logic digrams, minimizing
• Combinational logic circuits: definition, design; arithmetic LC; code converters; analysis
• Combinational logic circuits with integrated logic circuits: design; adders; magnitude comparator; decoder and demultiplexer; coder and multiplexer; ROM and programmable logic array
• Synchronous sequential logic circuits: concept; flip flops; analysis; design
• Asynchronous sequential logic circuits: analysis and design
• Registers, counters and memory units
• Algorithmic sequential logic circuits: flow chart; synchronization; design of control block
• A/D and D/A converters: conversion procedures

practical teaching

PA
Examples:
• number systems; arithmetic operations
• Boolean algebra theorems
• minimizing by map and tabulation methods
• design and analysis of combinational LC
• analysis and design of synchronous sequential LC
• analysis and design of asynchronous sequential LC
• design of counters, algorithmic sequential LC
• various types of A/D and D/A converters

PL
• Simulation of binary numbers and BCD code
• Physical interpretation of logical operations
• Logic gates
• Combinational LC; code converters
• Design with digital multiplexers
• Flip flops; synchronous and asynchronous sequential LC
• Counters, registers; memory unit; algorithmic sequential LC
• A/D and D/A converters

PZ
• Logic functions and gates, conventional and integrated combinational LC
• Design of synchronous and asynchronous sequential LC

prerequisite

• Basic knowledge of undergraduate calculus.
• Basic knowledge of undergraduate electrotechnics.

learning resources

1. Manuscript at http://au.mas.bg.ac.rs/Nastava-Kau/Nastava_Download.htm, DVL
2. Zoran Bučevac: Laboratory exercises for digital systems, Mechanical engineering faculty, Belgrade 2011, PRA, library and bookstore of MEFB
3. Power supply, oscilloscope, lab. for Digital systems, EOP/LEO
4. Protoboards, integrated circuits, Lab. for Digital systems, EOP/LEO
5. Freeware software, MEFB
6. PCs, Lab. for Digital systems and Computer lab. MEFB

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 12
laboratory exercises: 15
calculation tasks: 3
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 3
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 1
final exam: 5
assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 35
laboratory exercises: 5
calculation tasks: 25
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references

M. Morris Mano, Digital design, Prentice-Hall, New Jersey, 1984., KSJ, available in library of MEFB
A. D. Friedman, Fundamentals of logic design and switching, Computer Science Press Inc., Rockville, Maryland, 1986., KCJ
J. B. Peatman, Digital hardware design, McGraw-Hill, N.Y., 1980, KCJ
Fundamentals of biomedical engineering

**ID:** BSc-0723  
**teaching professor:** Матија Р. Лидија  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 4  
**final exam:** written  
**parent department:** control engineering

**goals**

Introducing students with fundamental similarities and differences of natural, biological and technical systems. Structural and functional basis of human organism. Physical and chemical methods and technics in diagnostics and therapy. Mastering basic knowledge's of theoretical and functional basis of instruments for measuring, apparatus and devices in biology and medicine.

**learning outcomes**

After passing exam student is capable to understand systematic fundaments human organism functioning, methods and techniques of diagnostics and therapy, principles of medical apparatus and devices functioning, as well as fundaments of biomedical software engineering.

**theoretical teaching**


**practical teaching**

Measurement of blood pressure, pulse and skin electro-conductivity, recording and data processing.

**prerequisite**

Requirements for attending are defined with curriculum of study program/module.

**learning resources**

Written materials for classes (handouts). Apparatus for blood pressure measurement, apparatus for skin electro-conductivity measurement.

**number of hours**

**total number of hours:** 45

**active teaching (theoretical)**

lectures: 20

**active teaching (practical)**
auditory exercises: 0
laboratory exercises: 12
calculation tasks: 0
seminar works: 1
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 2
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 3

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 10
calculation tasks: 0
seminar works: 20
project design: 0
final exam: 30
requirements to take the exam (number of points): 0

references

Fundamentals of optics, optical aids and devices

**ID:** BSc-0726  
**teaching professor:** Матија Р. Лидија  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 2  
**final exam:** written  
**parent department:** control engineering

**goals**

To familiarize students with the phenomena of light, the basics of geometric optics, the phenomenon of aberration and radiation, the detectors, and the working principle of the lasers and thermography and its applications in biomedical engineering.

**learning outcomes**

Mastering the skills related to optics, light, detectors, lasers and thermography a student acquires the ability to understand and design the device. The student is qualified to participate in the design and manufacture of contact lenses, eyeglass lenses and optical and optoelectronic instrument. The student will have basic knowledge regarding the working principle of lasers and their application in ophthalmology.

**theoretical teaching**

Theory of light and geometrical optics; Optical materials; Basic relations in geometrical optics; Light beams limitation; Concept of aberattion; Eye as an optical instrument and receiver of optical radiation; Radiometry and photometry; Absolutely black body and realistic body laws of radiation; Spreading of radiation trough atmosphere (absorption, scattering, transmission); Basic physical processes which are placed in detectors and basic detector parameters; Detectors classification; Physical principle of laser radiation; Basic types of laser radiation systems principle of working; Termovision functioning principle;

**practical teaching**

The production technology of contact and intraocular lenses. The technology of manufacturing eyeglass lenses. Characterization of contact lenses and eyeglass lenses. Practical work in the production of contact lenses (Optiks-Zemun). Practical work in optical laboratories (Institute of Physics).

**prerequisite**

Enrolled in the fourth semester of Bachelor studies

**learning resources**

1. Performed with written lessons (handouts), 2. Web's of ophthalmology, 3. Materials of companys Laserfocus and Optix, where the students have a part of their practical training

**number of hours**

total number of hours: 30

**active teaching (theoretical)**
lectures: 15

active teaching (practical)

auditory exercises: 0
laboratory exercises: 6
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 3
colloquium, with assessment: 3
test, with assessment: 0
final exam: 3

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 45
laboratory exercises: 0
calculation tasks: 0
seminar works: 15
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

David A. Atchison: Optics of the human eye, Elsevier Health Sciences, April 2000.
Human Anatomy and Physiology Systems

ID: BSc-0724
teaching professor: Матија Р. Лидија
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 4
final exam: written
parent department: control engineering

goals

Introducing students to basic concepts and terms of physiology and anatomy. Systematic approach to studying human organism as a whole with special emphasis on the importance of a certain human organs as a space-time musculoskeletal system. The study of anatomical and tissue characteristics of individual organs and organ systems for the design of devices for diagnostics and rehabilitation. Basis for nano-fractal analysis of human organism.

learning outcomes

After passing the exam the student is able to understand the basics of cell system, tissues, organs and human body functioning. Student is introduced to basic methods and techniques in the diagnosis and treatment of functional conditions of organs and subsystems of the human body is learned.

theoretical teaching


practical teaching

prerequisite

Registered student of 3rd semester.
Desirable: Fundamentals of Biomedical Engineering

learning resources

1. Written course material (handouts).
2. Jovanovic Т., Physiology (Физиологија), Faculty of Medicine, Belgrade, 2005

number of hours

total number of hours: 45

active teaching (theoretical)

lectures: 28

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 8
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 6
final exam: 3

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 40

references

Dragicevic,A.,Golubovic Z., Muncan J., Practicum on system anatomy and physiologist, Faculty of Mechanical Engineering, 2011
INTRODUCTION TO AUTOMATIC CONTROL

ID: BSc-0041
teaching professor: Лазић В. Драган
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: control engineering

goals

Introduction to basic concepts in the field of Automatic Control and training for implementation and verification of acquired knowledge to specific physical systems and processes.
Acceptance of some methodologies for analytical and experimental verification of the basic static and dynamic characteristics and parameters of the system.
Learning basic MATLAB tools to help in calculation and simulation of all of the computational parts of this subject.

learning outcomes

Getting basic knowledge of the automatic control.
Identify and use the methods needed for analysis and synthesis of the controllers as a part of the control system, as well as the whole automatic control system.
For proper use of computers and MATLAB in solving the main problems of the control systems, as well as other engineering problems.
To be analytical and / or experimentally investigated the basic dynamic and static characteristics of the system

theoretical teaching

Introduction to basic concepts and terms in the field of the automatic control. Basic concepts of the automatic control. The control systems of basic physical values (position, level, pressure, flow, temperature, speed, ...) illustrated the most frequent objects and processes in mechanical engineering. The basic dynamic and static characteristics and parameters of the system in time domain, their analytical determination (time constant, rise time, settling time, overshoot, gain, static error, ...). The transfer function of the system. Block diagrams. Frequency response of the system. The main indicators of the system in the domain of frequency response (resonance frequency, attenuation, bandwidth, ...). The basic types of control systems: P, PI, PID and their impact on the dynamic and static properties of the system through the commonly used objects and processes in mechanical engineering. The concept of stability criterion for the stability checking of linear systems.

practical teaching

Practical training shall include all the above experimental methods, and training is based on simulation using MATLAB.
Presentation of the systems and physical values by the standard symbols, labels and understanding of control principles based on design documentation.
Experimental evaluation of the main system parameters in the time domain (time constant, rise time, settling time, overshoot, gain, static error, ...).
The transfer function, experimental determination and significance.
Frequency response of the system, the experimental determination and significance.
Hydraulic servo systems, servo valves, hydraulic cylinders.
prerequisite

Basic computer knowledge founded on PCs platforms, basic knowledge of higher education mathematics.

learning resources

- Literature on the website http://au.mas.bg.ac.rs/el - Moodle
- Licensed Software in the possession of faculties.
- Freeware software.
- PCs.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 9
laboratory exercises: 0
calculation tasks: 10
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 5
research: 4

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 8
test, with assessment: 2
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 20

references
Process modeling

**ID:** BSc-0675  
**teaching professor:** Дебељковић Љ. Драгутин  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** control engineering

**goals**

Student should be familiar with basic principle and steps of mathematical modeling of objects and processes. To be capable to form basic balance equations which describes non-stationary states of objects and processes which, after suitable choice of state variables, manipulated and control variables as well as disturbances variables enables one to form adequate and non-unique state space representations of objects and processes for the needs of further analyzing or synthesis.

**learning outcomes**

To be familiar and to be capable to use the basic principle of mathematical modeling applied to: dynamics of material handling, flow processes, flow-thermal processes, machine dynamics, traffic and transportation dynamics and contemporary plants existing in area of general energetic. Moreover it is expected to be capable to perform elementary analysis of their transient response characteristics from the above mentioned list of objects and processes.

**theoretical teaching**

Mathematical modeling of objects and processes - general approach.  
Ideas, rules, conditions, limitations and use of models.  
Kinematics and dynamics of materials handling.  
Fluid in motion - Dynamics of flow processes.  
Thermal-flow dynamics.  
Mass transfer dynamics  
Heat exchangers dynamics.  
Machine and motor dynamics.  
Dynamics of traffic and transportation processes.  
Aerospace dynamics.  
Ship dynamics.  
Energetic plant dynamics.

**practical teaching**

Water level system dynamics. The mathematical model of incompressible flow throughout the long pipes. The mathematical model of compressible flow process throughht the classical reservoir with two valves. Model of rigid and elastic water shock. Floor heating process.  
Temperature distribution within the closed room without and with air circulation. Steam generator model and dynamics. Model of nuclear power plant - discussion. The mathematical model of gas turbine plant- model and discussions.  
Analysis of elementary chemical processes.  
Laboratory work: Level systems dynamics. Transportation process and the process of storage, holdup and inventory systems. Heat exchangers dynamics.

**prerequisite**

Faculty of Mechanical engineering — course catalog — B.Sc. (undergraduate) academic studies
Exams from the following subjects should be given: All Mechanics, Thermodynamics and Fluid mechanics.

**learning resources**


**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 16
laboratory exercises: 4
calculation tasks: 0
seminar works: 6
project design: 4
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 2
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 20
project design: 10

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89
final exam: 30
requirements to take the exam (number of points): 35

references

Professional Practice

ID: BSc-0379

teaching professor: Рибар Н. Срђан

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 1

final exam: seminar works

parent department: control engineering

goals

practical experience in the environment in which the student will realize his professional career. Identifying the basic functions of the business system in the field of design, development and production, as well as the roles and tasks of mechanical engineering in such a business system.

learning outcomes

Students get practical experience on the organization and functioning of the environment in which they will apply their knowledge in their future professional career. Student identifies models of communication with colleagues and business information flows. The student recognizes the basic processes in the design, manufacture, maintenance, konktestu in his future professional competence. Establish the personal contacts and relationships that will be able to use during training or entering future employment.

theoretical teaching

practical teaching

prerequisite

learning resources

number of hours

total number of hours: 48

active teaching (theoretical)

lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 1
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 1
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 90
project design: 0
final exam: 10
requirements to take the exam (number of points): 0

references
Professional practice B - CS

ID: BSc-0633
teaching professor: Лазић В. Драган
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 1
final exam: seminar works
parent department: control engineering

goals

Practical experience and students stay in the environment in which the student will realize his professional career. Identifying the basic functions of the business system in the field of design, development and production, as well as the roles and tasks of mechanical engineering in such a business system.

learning outcomes

Students obtain practical experience on how the organization and functioning of the environment in which they will apply their knowledge in their future professional career. Student identifies models of communication with colleagues and business information flows. Student identifies the core processes in the design, manufacture, maintenance, in the context of his future professional competence. Establish the personal contacts and relationships that will be able to use at school or entering into future employment.

theoretical teaching

practical teaching

Practical work involves working in organizations that perform various activities in connection with mechanical engineering. Selection of thematic areas and industrial or research organizations conducted in consultation with the concerned teacher. In principle a student can perform in practice: production companies, design and consulting organizations, organizations concerned with maintaining mechanical equipment, public utility companies and some of the laboratories at Faculty of Mechanical Engineering. The practice may also be made abroad. During practice, students need to keep a diary in which to enter a description of operations performed, the conclusions and observations. Once completed practice must make a report to defend the subject teacher. The report is submitted in the form of the paper.

prerequisite

learning resources

number of hours

total number of hours: 46

active teaching (theoretical)

lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
Student practice B - BSc

ID: BSc-0725

**teaching professor:** Матија Р. Лидија
**level of studies:** B.Sc. (undergraduate) academic studies
**ECTS credits:** 1
**final exam:** seminar works
**parent department:** control engineering

**goals**

The goal of the course is introducing students with operation and maintenance of instruments, apparatus and devices in different areas of medicine, especially in clinics and health centers. Professional practice should enable students to easier ad quicker master technical courses, especially in area of early diagnostics of skin cancer and melanoma, ophthalmology, refractive surgery, dentistry, obstetrics...

**learning outcomes**

With mastering the course program, students get familiar with:
1. organizational problems of clinics, especially informational processes, databases
2. functioning and maintenance of instruments for measurements, apparatus, and devices for diagnostics and therapy
3. processes of maintenance of instrumentation, apparatus, and devices.

**theoretical teaching**

Introducing students with implementation of practice, procedures, rules, documents related to protection on work.

Schedule of practice.

**practical teaching**

Visits to ordinations, hospitals, and health centers.

Getting familiar with realistic work conditions in our country, and establishment of communication system with doctors (adaptation on medical terminology).

Apparatus and devices management for early diagnostics of cancer and melanoma, ophthalmic procedures for constitution of sight.

Interpretation of obtained results from the aspect sensitivity and specificity of obtained results.

Analysis of functioning of apparatus for ultrasound, ECG, EEG,..

Recording and analysis of information pathways, making the data base in clinics, Introducing the medical instrumentation.

**prerequisite**

Attending practice in the institution.

**learning resources**

Nanolab 1 and 2 at the Faculty of Mechanical Engineering.

**number of hours**

total number of hours: 46

**active teaching (theoretical)**
lectures: 2

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 4
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 40

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 20
calculation tasks: 0
seminar works: 40
project design: 0
final exam: 30
requirements to take the exam (number of points): 25

references

Practicum for Biomedical Engineering (handout).
Practicum in anatomy and human physiology for engineers (working paper).
Practicum in biomedical devices and appliances (working paper).
Systems of Control

ID: BSc-0632

teaching professor: Рибар Б. Зоран

level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written

parent department: control engineering

goals

• Introduction in automatic control systems by illustrative examples.
• Knowledge needed for proper understanding of digital control significance and diversity as well as getting of the basis for further deepening to the analyze and design methodologies and real time control.
• Introduction to basic of nonlinear systems and their characteristics.
• Understanding of fuzzy approach to modeling phenomenon, process and systems, and control.
• Basic components of control systems. Simulation of these components in Simulink.
• Introduction in virtual instrumentation. Measurement and acquisitio by LabView.
• Introduction in software packages for analysis of automatic control systems Matlab and Simulink.
• Introduction in simulation and control of robotic systems. Example on software package and on real robotic system.

learning outcomes

• Knowledge necessary for basic overview of automatic control in mechanical engineering.
• Knowledge and understanding of nonlinear problems and phenomena in the processes and plants, mathematical description and analysis.
• Knowledge and understanding of fuzzy set, fuzzy logic and fuzzy control theory.
• Knowledge needed for proper understanding of digital control significance and diversity as well as getting of the basis for further deepening to the analyze and design methodologies and real time control.
• Introduction in design testing and control of automatic systems by digital computer.

theoretical teaching

Introduction in software packages for analysis of automatic control systems Matlab and Simulink.
Introduction in simulation and control of robotic systems. Example on software package and on real robotic system.

practical teaching

Laboratory practice in automatic control laboratory on real plants and real automatic control systems. Digital computer practice in program packages for automatic control field.
prerequisite

learning resources

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 20
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 20
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 0

references
engineering materials and welding, tribology, fuels and combustion

Basic of welding B
Combustion
Conventional welding processes
Design and testing of welded structures
Design and testing of welded structures
Engineering materials 1
Engineering materials 2
Foundations of biomaterials
Friction and Wear of Materials
Fuel and Combustion
Fuel and Industrial Water
Fuel, Lubricants and Industrial Water
Professional practice B-WWS
Repair Welding and Surfacing
Tribology
Tribotechnique
Basic of welding B

ID: BSc-0368

**teaching professor:** Прокић-Цветковић М. Радица

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** engineering materials and welding, tribology, fuels and combustion

**goals**

The aim of this course is for students to become competent in the area of welding. This course is designed to provide information through theoretical lectures, computational classes and seminar papers, but also through welding workshop practice. They should also develop appropriate academic skills needed for the profession and become informed with the specificity of each welding process and appropriate equipment.

**learning outcomes**

After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Basic of welding B using acquired knowledge, as well as to comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine acquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.

**theoretical teaching**


**practical teaching**


**prerequisite**

Engineering materials 1 and Engineering materials 2

**learning resources**

total number of hours: 75

**active teaching (theoretical)**

lectures: 20

**active teaching (practical)**

auditory exercises: 9
laboratory exercises: 8
calculation tasks: 4
seminar works: 14
project design: 0
consultations: 2
discussion and workshop: 3
research: 0

**knowledge checks**

check and assessment of calculation tasks: 1
check and assessment of lab reports: 1
check and assessment of seminar works: 2
check and assessment of projects: 0
colloquium, with assessment: 2
test, with assessment: 4
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 35
laboratory exercises: 10
calculation tasks: 5
seminar works: 15
project design: 0
final exam: 30
requirements to take the exam (number of points): 40

**references**

Combustion

ID: BSc-0730
teaching professor: Стојиљковић Д. Драгославa
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: engineering materials and welding, tribology, fuels and combustion

goals


learning outcomes

Mastering the techniques of calculation of material and energy balance of the combustion process. Mastering the techniques of flame investigation. Acquiring knowledge on the control of the combustion efficiency. Acquiring knowledge about the impact of combustion products on the environment.

theoretical teaching


practical teaching

Chemical kinetics, chemical equilibrium problem solving and speed of chemical reactions in combustion. Dissociation products of combustion, the calculation of the amount and composition of the products of combustion and combustion temperature. Incomplete combustion, determination of the amount and composition of the products of combustion and combustion temperature. Length of laminar flames, influential properties, experimental determination. The boundaries of stable combustion, the definition and experimental determination. Ignition limits (concentrations). Flame front propagation speed.

prerequisite

Fuel, Lubricants and Industrial Water

learning resources

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 8
laboratory exercises: 20
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 2
check and assessment of lab reports: 3
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 40
laboratory exercises: 10
calculation tasks: 5
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references

D. Draskovic, M. Radovanovic, M. Adzic: Combustion
M. Radovanovic: Manual for laboratory exercises in the combustion
Milan Radovanovic: Fuels
M. Adzic, A. Rac, S. Memetović: Manual for laboratory exercises in the Fuels
Conventional welding processes

ID: BSc-0536  
teaching professor: Поповић Д. Оливера  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 4  
final exam: written+oral  
parent department: engineering materials and welding, tribology, fuels and combustion

goals

The aim of this course is for students to become competent in the area of welding. This course is designed to provide information through theoretical lectures, computational classes and seminar papers, but also through welding workshop practice. They should also develop appropriate academic skills needed for the profession and become informed with the specificity of each welding process and appropriate equipment.

learning outcomes

After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Conventional welding processes using acquired knowledge, as well as to comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine acquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.

theoretical teaching


practical teaching


prerequisite

Attended course lectures and finished exercises of Engineering materials 1 and Engineering materials 2.

learning resources

number of hours

total number of hours: 45

active teaching (theoretical)

lectures: 12

active teaching (practical)

auditory exercises: 8
laboratory exercises: 5
calculation tasks: 4
seminar works: 8
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 1
test, with assessment: 2
final exam: 3

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 35
laboratory exercises: 10
calculation tasks: 5
seminar works: 10
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

Design and testing of welded structures

ID: BSc-0492

teaching professor: Радаковић Ј. Зоран

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: engineering materials and welding, tribology, fuels and combustion

goals

After having completed the course, along with the theory and practical classes (through problems and calculation exercises, seminars etc.), the student acquires the proper academic knowledge and skills in the field of weld design, and stress state analysis of the welded structure. Also, candidates will be familiar with the modern testing and inspection techniques applied to welded structures in service.

learning outcomes

Having mastered the material of the course, envisaged through the course programme, the student is capable of solving real problems dealing with the welded structure calculations and testing, and is able to perceive eventual effects that may result in the case of poor solutions, or that are the consequences from fatigue and damage of the material. The student is then also capable of connecting the knowledge acquired in this field with other fields, and to successfully apply it in practice.

theoretical teaching


practical teaching


prerequisite


learning resources

1. Z. Petkovic, D. Ostric, Metallic Structures in the Machine Building Industry 1, (in Serbian) University of Belgrade, Faculty of Mechanical Engineering, Belgrade, 1996 (or later).
2. Written text from class lectures and exercises, presentations (notes/handouts).
3. Internet resources.
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 10
seminar works: 10
project design: 0
consultations: 5
discussion and workshop: 5
research: 0

knowledge checks

check and assessment of calculation tasks: 5
check and assessment of lab reports: 0
check and assessment of seminar works: 5
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 2
final exam: 3

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 25
laboratory exercises: 0
calculation tasks: 15
seminar works: 15
project design: 0
final exam: 40
requirements to take the exam (number of points): 40

references

T. Lassen, N. Recho, Fatigue Life Analyses of Welded Structures, ISTE ltd., USA, 2006.
Design and testing of welded structures

ID: BSc-0229

teaching professor: Седмак С. Александар

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: oral

parent department: engineering materials and welding, tribology, fuels and combustion

goals

Objectives of the course are that students, after completing the theoretical course of calculation and testing of welded structures, as well as engaging in practical training (through the labs, performing computational exercises, making seminar papers, etc.), become competent in the field of welding and gain appropriate academic skills, and also develop creative skills and acquire specific practical skills.

learning outcomes

By successfully completing the study program, provided by the subject curriculum, the student is able to solve real life problems of calculating and testing of welded structures, and to examine possible consequences that may occur in case of bad solutions. The student is also able to link acquired knowledge in this field with other areas and apply them in practice.

theoretical teaching


practical teaching


prerequisite

required: Materials strength, Mechanics, Fundamentals of structure integrity, Basic of Welding Process and Mechanical materials 1 and 2

learning resources

A. Sedmak, Design and testing of welded structures, script, Faculty of Mechanical Engineering, Belgrade, 2008.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 20
active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 20
seminar works: 10
project design: 0
consultations: 5
discussion and workshop: 5
research: 0

knowledge checks

check and assessment of calculation tasks: 5
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 5
laboratory exercises: 0
calculation tasks: 25
seminar works: 15
project design: 10
final exam: 40
requirements to take the exam (number of points): 40

references
Engineering materials 1

ID: BSc-0035

teaching professor: Прокић-Цветковић М. Радица

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 2

final exam: written+oral

parent department: engineering materials and welding, tribology, fuels and combustion

goals

The aim of this course is for students to become competent in the area of welding. This course is designed to provide information through theoretical lectures, computational classes and seminar papers, but also through welding workshop practice. They should also develop appropriate academic skills needed for the profession and become informed with the specificity of each welding process and appropriate equipment.

learning outcomes

After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Engineering materials 1 using acquired knowledge, as well as to comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine acquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.

theoretical teaching


practical teaching


prerequisite

Defined by subject curriculum.
learning resources

1. V. Djordjevic, Engineering materials, Faculty of Mechanical Engineering, Belgrade, 1999.
2. L. Sidjanin, Engineering materials 2, FTN Novi Sad, 1996.

number of hours

total number of hours: 30

active teaching (theoretical)

lectures: 8

active teaching (practical)

auditory exercises: 5
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 3
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 1
test, with assessment: 1
final exam: 2

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 25
laboratory exercises: 35
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 40

references

Engineering materials 2

ID: BSc-0036

**teaching professor:** Шијачки Жеравчић М. Вера

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** engineering materials and welding, tribology, fuels and combustion

**goals**

The aim of this course is for students to become competent in the area of Engineering materials 2. They should also develop appropriate academic skills and creativity and master practical skills needed for the profession. This course is designed to provide information through theoretical lectures but also through laboratory type (practical) exercises, computational classes and seminar papers students are responsible for writing.

**learning outcomes**

After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Engineering materials 2 using acquired knowledge, as well as to comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine acquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.

**theoretical teaching**


**practical teaching**


**prerequisite**

Necessary conditions for a student to attend this course are: attended course lectures and finished exercises of Engineering materials 1.

**learning resources**
2. V. Đorđević, Mašinski materijali, Mašinski fakultet, Beograd, 1999

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 20

**active teaching (practical)**

auditory exercises: 14
laboratory exercises: 24
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 6
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 40

**references**
Foundations of biomaterials

ID: BSc-0557

**teaching professor:** Шијачки Жеравчић М. Вера

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** engineering materials and welding, tribology, fuels and combustion

**goals**

The aim of this course is to introduce students to different types of biomaterials and their properties with the goal of understanding and studying the possibility of using biomaterials in human organism. Special attention is devoted to the appearance of damage and failure of biomaterials which are in contact with or are within human body, as well as consequences due to these processes. This course enables possible collaborations between experts in the fields of material science and medicine, more particularly it enables work with specialized clinics and laboratories that conduct research and engineering of biomaterials.

**learning outcomes**

Attending this course student will develop abilities of all encompassing analysis of the problem of the contact between the artificial biomaterial and living organism, and the potential to predict optimal choice of biomaterial using scientific methods as well as present-day lab equipment. Due to this course a student will also develop the ability to combine knowledge from different areas of material science, biology, physics, mechanics and physiology together with learned biomedical engineering.

**theoretical teaching**

Basic types of biomaterials and comparison of their physical, chemical and mechanical properties. Biocompatibility. Metal biomaterials, their advantages and disadvantages. Application of metal biomaterials in medicine and stomatology. Ceramic biomaterials, types, structure and properties. Ceramic biomaterials in medicine and stomatology. Polymer based biomaterial, artificial and natural, production process, structure, types and properties. Sterilization. Composite biomaterials, types, structure and properties.

**practical teaching**


**prerequisite**

Necessary conditions: Engineering materials 1 and 2. Desired conditions: The introduction to biomedical engineering, Human Anatomy and Physiology.

**learning resources**
5. V.V.Vasiliev, E.V.Morozov, Mechanics and analysis of composite materials, 2001 Elsevier, KCJ

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 20

**active teaching (practical)**

auditory exercises: 15
laboratory exercises: 3
calculation tasks: 5
seminar works: 12
project design: 0
consultations: 2
discussion and workshop: 3
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 2
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 4
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 25
laboratory exercises: 5
calculation tasks: 5
seminar works: 25
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

**references**
J. Lemons, Ceramics: Past, present, future, Bone 19 No1(1996) 121S-128S

/
Friction and Wear of Materials

ID: BSc-0518

**teaching professor:** Венцл А. Александар

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 2

**final exam:** oral

**parent department:** engineering materials and welding, tribology, fuels and combustion

**goals**

The student attending this course should:

- Comprehend the significance of friction, wear and lubrication (tribology keywords) and the problems connected with it, the field of construction and maintenance of mechanical parts and systems;
- Master the fundamental knowledge of materials friction and wear process in order to decide the merits of the choice of materials for the construction and tribological components;
- Solve problems related to the prevention of wear and competently decide on techniques to improve tribological properties of materials.

**learning outcomes**

Based on the mastered knowledge the student is qualified to:

- Solves the complex tribological problems, with multi-disciplinary approach, in order to ensure the high reliability of machinery and equipment;
- Critically analyze the designed constructions from the standpoint of friction and wear, assessing possible effects on the reliability;
- Propose the solutions for reduction of energy and materials dissipation in the machines.

**theoretical teaching**

- Tribology as a science and technical disciplines and techno-economical importance of tribology.
- Properties of surfaces and the nature of contact of two bodies.
- Friction – the basic causes and principles; Friction of metals and non-metals.
- Wear – mechanisms and types; Wear calculation and measuring methods; Wear prevention.
- Properties of materials for tribological components; Technologies for improving the tribological properties of materials.

**practical teaching**

- Tribological losses in the industry and transportation; Tribological improvements studies.
- Characterization of the tribological surfaces; Methods and apparatus for surface roughness measuring; Surface roughness standards; Influence of material processing and machining on the surface roughness; Properties of surface layers.
- Presentation of worn surfaces and machine parts failure due to wear, and wear products (debris).
- Presentation of materials for tribological components and technologies for improving the tribological properties of materials.
- Laboratory practice: “Experimental methods for evaluation of friction and wear”; Measuring of coefficient of friction and wear values for different materials and test conditions.

**prerequisite**

**learning resources**
1. Handouts for each lecture.
4. Pin-on disc tribometer; Block-on-ring disk tribometer; Four Ball machine.

**number of hours**

total number of hours: 30

**active teaching (theoretical)**

lectures: 12

**active teaching (practical)**

auditory exercises: 2
laboratory exercises: 6
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 4
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 2
final exam: 3

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 55
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

**references**

Fuel and Combustion

**ID:** BSc-0038  
**teaching professor:** Стојиљковић Д. Драгослава  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** oral  
**parent department:** engineering materials and welding, tribology, fuels and combustion

**goals**


**learning outcomes**

Acquisition of basic knowledge of fuels, their types and characteristics. Mastering the basic techniques of calculation of quantity and composition of the products of combustion and combustion temperature. Acquisition of basic knowledge about the processes of friction and wear, the types and characteristics of lubricants. Acquiring basic knowledge on types of water, their properties and preparation of water for industrial use. Mastering the techniques of calculation of material and energy balance of the combustion process. Acquiring knowledge about the impact of combustion products on the environment.

**theoretical teaching**


**practical teaching**

prerequisite

No special requirements.

learning resources


number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 8
laboratory exercises: 20
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 2
check and assessment of lab reports: 3
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 40
laboratory exercises: 10
calculation tasks: 5
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references
Fuel and Industrial Water

ID: BSc-0251

teaching professor: Стојиљковић Д. Драгослава

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: oral

parent department: engineering materials and welding, tribology, fuels and combustion

goals


learning outcomes

Acquisition of basic knowledge about the concept of fuel, types and properties. Mastering the basic techniques of calculation of quantity and composition of the products of combustion and combustion temperature. Acquiring basic knowledge on the characterization of solid fuels, their origins, derivation and application. Basic knowledge of liquid and gaseous fuels, their origins, derivation and application. Basic knowledge about water and methods of preparation for industrial application.

theoretical teaching


practical teaching


prerequisite

No special requirements.

learning resources

Milan Radovanovic: Fuels; Milan Radovanovic: Industrial water; Aleksandar Rac: Lubricants; M. Adzic, A. Rac, S. Memetović: Manual for laboratory exercises in Fuels;

number of hours
total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 8
laboratory exercises: 20
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 2
check and assessment of lab reports: 3
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 40
laboratory exercises: 10
calculation tasks: 5
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references
Fuel, Lubricants and Industrial Water

ID: BSc-0054  
teaching professor: Стојиљковић Д. Драгослава  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 6  
final exam: oral  
parent department: engineering materials and welding, tribology, fuels and combustion

goals


learning outcomes

Acquisition of basic knowledge about the concept of fuel, types and properties. Mastering the basic techniques of calculation of quantity and composition of the products of combustion and combustion temperature. Acquiring basic knowledge on the characterization of solid fuels, their origins, derivation and application. Basic knowledge of liquid and gaseous fuels, their origins, derivation and application. Basic knowledge about the types of lubricants, properties and application. Basic knowledge about water and preparation for use in industrial purposes.

theoretical teaching


practical teaching


prerequisite

learning resources

Milan Radovanovic: Fuels; Milan Radovanovic: Industrial water; Aleksandar Rac: Lubricants; M. Adzic, A. Rac, S. Memetović: Manual for laboratory exercises in Fuels;
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 8
laboratory exercises: 20
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 2
check and assessment of lab reports: 3
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 40
laboratory exercises: 10
calculation tasks: 5
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references
Professional practice B-WWS

ID: BSc-0483

teaching professor: Седмак С. Александар

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 1

final exam: seminar works

parent department: engineering materials and welding, tribology, fuels and combustion

goals

Objectives of this course are that students, after completing theoretical training, are prepared for their maximum involvement in practical training. Objective is that students become competent in the field of welding and gain appropriate academic skills, and also develop specific creative and practical skills that are needed in professional practice.

learning outcomes

By attending this course, provided by the curriculum of the subject, the student will be able to solve particular problems from practice, and to examine the possible consequences that may occur in case of bad solutions. The student will also be able to link their knowledge from various fields and apply them in practice.

theoretical teaching

Introducing students to problems in practice.

practical teaching

Professional practice performance in the selected individual firms. Writing a report after practice.

prerequisite

required: Mechanical materials 1 and 2

learning resources

[1] Written lessons from lectures (handouts)
[3] Excerpts from the standard

number of hours

total number of hours: 46

active teaching (theoretical)

lectures: 6

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 35
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 5
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 100
project design: 0
final exam: 0
requirements to take the exam (number of points): 40

references
Repair Welding and Surfacing

ID: BSc-0262
teaching professor: Шијачки Жеравчић М. Вера
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: engineering materials and welding, tribology, fuels and combustion

goals

The aim of this course is to provide students with an introductory knowledge of the reparation of machine parts and construction, and the ability to solve concrete problems. This course is designed to provide information through theoretical lectures but also through laboratory type (practical) exercises, computational classes and seminar papers students are responsible for writing. Throughout this course students would also develop teamwork skills and the ability to combine knowledge from different areas of material and engineering sciences.

learning outcomes

After fulfilling all the course requirements, a student has knowledge to recognize different aspects of damage of machine parts and constructions, as well as prescribe the technology of their reparation.

theoretical teaching


practical teaching

Damage and destruction of machine parts and constructions. Visual control and analysis of damaged areas. Prescription of the reparation technology. Homework assignments. Reparation technology of gears, rolling bearings and shafts. Lab exercises in machine shops devoted to repair welding and demonstration of reparation of an example machine part. Calculations of required material during repair welding. Reparation technology of welded constructions, tools, equipment under pressure and equipment and parts of thermoenergetical facilities.

prerequisite

Necessary conditions: Engineering materials 1, Engineering materials 2, Machine elements 1, Machine elements 2 and Basic of Welding.

learning resources

2. V. Šijački Žeravčić, A. Milosavljević, A. Sedmak, Priručnik za mašinske materijale-zavarivanje, lemljenje i livenje.
5. Additional required materials (handouts, exercise examples etc.) are posted on the course web page or are given to the students in paper form. Other electronic course material can be provided directly to students attending the class. Lectures are realized using PowerPoint presentations and blackboard.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 5
calculation tasks: 11
seminar works: 9
project design: 0
consultations: 2
discussion and workshop: 3
research: 0

**knowledge checks**

check and assessment of calculation tasks: 2
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 3
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 35
laboratory exercises: 10
calculation tasks: 5
seminar works: 15
project design: 0
final exam: 30
requirements to take the exam (number of points): 40

**references**

B. Sabo et al., Zavarljivost nerđajućih čelika-priručnik, N.Sad,1995
Krsmanović V., Mitrović R., Klizni i kotrljajni ležaji, Mašinski fakultet, Beograd, 2004
Tribology

ID: BSc-0517

teaching professor: Венцл А. Александар

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: oral

parent department: engineering materials and welding, tribology, fuels and combustion

goals

The student attending this course should:
• Comprehend the significance of friction, wear and lubrication (tribology keywords) and the problems connected with it, the field of construction and maintenance of mechanical parts and systems;
• Master the fundamental knowledge in these areas of tribology in order to decide the merits of the choice of materials and lubricants for the construction and tribological components;
• Solve problems related to the prevention of wear and competently decide on techniques to improve tribological properties of materials and lubrication technologies.

learning outcomes

Based on the mastered knowledge the student is qualified to:
• Solves the complex tribological problems, with multi-disciplinary approach, in order to ensure the high reliability of machinery and equipment;
• Critically analyze the designed constructions from the standpoint of friction and wear, assessing possible effects on the reliability;
• Use methods for solving problems of mechanical parts and systems lubrication, including the selection of lubricants as a structural element;
• Propose the solutions for reduction of energy and materials dissipation in the machines.

theoretical teaching

• Tribology as a science and technical disciplines and techno-economical importance of tribology.
• Properties of surfaces and the nature of contact of two bodies.
• Friction – the basic causes and principles; Friction of metals and non-metals.
• Wear – mechanisms and types; Wear calculation and measuring methods; Wear prevention.
• Properties of materials for tribological components; Technologies for improving the tribological properties of materials.
• Lubricants – role, type, classification and basic properties; Rheology of lubricants.
• Forms and types of lubrication; Hydrostatic, hydrodynamic, elastohydrodynamic and boundary lubrication.
• Lubrication systems (tasks and roles; procedures and classification; elements definition) and lubricants selection.
• Lubrication services organization and lubricants ecology.

practical teaching

• Tribological losses in the industry and transportation; Tribological improvements studies.
• Characterization of the tribological surfaces; Methods and apparatus for surface roughness measuring; Surface roughness standards; Influence of material processing and machining on the surface roughness; Properties of surface layers.
• Presentation of worn surfaces and machine parts failure due to wear, and wear products (debris).
• Presentation of materials for tribological components and technologies for improving the tribological properties of materials.
• Laboratory practice: “Experimental methods for evaluation of friction and wear”; Measuring of coefficient of friction and wear values for different materials and test conditions.
• Classifications and specifications of lubricants; Methods for lubricants testing.
• Examples and formulas for calculation and design of the tribological elements concerning type of lubrication.
• Laboratory practice: “Experimental methods for evaluation of lubricants basic properties and rheological properties”; Measuring of: flash point and pour point; acid and total base number; foaming tendency; oxidation stability; ash, water and mechanical impurities contents; viscosity and viscosity index.

prerequisite

learning resources

1. --, Handouts for each lecture.
5. Pin-on disc tribometer; Block-on-ring disk tribometer; Four Ball machine.
6. Various devices for measuring the basic characteristics of liquid lubricants and greases; Viscometer for liquid lubricants; Pressure grease viscometer.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 17
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 11
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 2
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 4
final exam: 5
assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 55
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

Tribotechnique

ID: BSc-0371

**teaching professor:** Венціл А. Александар
**level of studies:** B.Sc. (undergraduate) academic studies
**ECTS credits:** 6
**final exam:** oral
**parent department:** engineering materials and welding, tribology, fuels and combustion

**goals**

The student attending this course should:

- Master the fundamental knowledge in the areas of lubricants and lubrication;
- Comprehend the significance of failures from the technical and economic aspects;
- Master the skills to evaluate the failure according to the established cause-consequence classifications;
- Comprehend the issue of establishing a diagnostic of machine condition and monitoring programme;
- Increase the availability and productivity of the equipment through a clearly defined technical strategy and to make competent decisions on it.

**learning outcomes**

Based on the mastered knowledge the student is qualified to:

- Conducts an analysis of the problems connected with maintenance and competently decides on the maintenance program in the tribotechnique area;
- Selects and uses the modern methods for condition-diagnostic and condition-monitoring of the tribological systems;
- Make conclusions, based on monitoring results, about ways how to prevent the failure;
- Carry-out all the maintenance measures in tribotechnique domain and systematically introduce them into the working practice with the aim to reduce the losses due to friction and wear.

**theoretical teaching**

- Introductory lecture – The objectives and tasks of tribotechnique.
- Lubricants – role, type, classification and basic properties; Rheology of lubricants.
- Forms and types of lubrication; Hydrostatic, hydrodynamic, elastohydrodynamic and boundary lubrication.
- Lubrication systems (tasks and roles; procedures and classification; elements definition) and lubricants selection.
- Lubrication services organization and lubricants ecology.
- The role, objectives and techniques of failure analysis and condition-diagnostics in the construction and maintenance of mechanical systems (casual, permanent, partial, immediate and gradual failure); Failure analysis.
- Tribotechnique activities and sustainable development (maintenance methods, road map to excellence, performance benchmark);
- Lubricants monitoring and the diagnostic methods for tribological components and systems condition.

**practical teaching**

- Classifications and specifications of lubricants; Methods for lubricants testing.
- Laboratory practice: “Experimental methods for evaluation of lubricants basic properties and rheological properties”; Measuring of: flash point and pour point; acid and total base number;
foaming tendency; oxidation stability; ash, water and mechanical impurities contents; viscosity and viscosity index.

• Examples and formulas for calculation and design of the tribological elements concerning type of lubrication.

• Examples of failure analysis techniques (Fault tree analysis, Ishikawa diagram, Pareto analysis, FMEA, etc.) and their application to the specific tribological components failure case studies;

• Presentation of tribological components damages and failures of, and wear products (debris); Presentation of equipment for tribological components diagnostics.

prerequisite

learning resources

1. --, Handouts for each lecture.
3. M. Babić, Lubricating Oil Monitoring, Faculty of Mechanical Engineering, Kragujevac, 2004 (in Serbian).
4. Various devices for measuring the basic characteristics of liquid lubricants and greases; Viscometer for liquid lubricants; Pressure grease viscometer.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 9
calculation tasks: 3
seminar works: 7
project design: 0
consultations: 11
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 3
check and assessment of projects: 0
colloquium, with assessment: 2
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 50
laboratory exercises: 5
calculation tasks: 0
seminar works: 10
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

fluid mechanics

Fluid mechanics
Fluid Mechanics B
Hydraulics and pneumatics
Fluid mechanics

ID: BSc-0684

teaching professor: Црнојевић Ђ. Цветко

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: fluid mechanics

goals

learning outcomes

theoretical teaching

practical teaching

prerequisite

learning resources

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 26

laboratory exercises: 4

calculation tasks: 0

seminar works: 0

project design: 0

consultations: 0

discussion and workshop: 0

research: 0

knowledge checks

check and assessment of calculation tasks: 0

check and assessment of lab reports: 2

check and assessment of seminar works: 0

check and assessment of projects: 0

colloquium, with assessment: 5

test, with assessment: 3

final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5

test/colloquium: 45

laboratory exercises: 10

calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 20

references
Fluid Mechanics B

ID: BSc-0059
teaching professor: Чантрак М. Светислав
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: fluid mechanics

goals

Aims of the course is to introduce students to basic principles and laws in fluid mechanics. Deeper understanding of basic equations of fluid mechanics allows the student to successfully apply them process of finding the solution to specific engineering problems, and also improves his scientific and practical development.

learning outcomes

With successful completion of the study of fluid mechanics student acquires the following knowledge and general skills: analytical thinking, mastering the latest methods and processes of research, application of knowledge in practice, linking basic knowledge in various fields of engineering, creativity, and so on.

theoretical teaching


practical teaching

**prerequisite**

Passed exams in following courses: Mathematics 1, Mathematics 2, Mathematics 3, Mechanics 1, Mechanics 2 and Mechanics 3

**learning resources**

Books of professors from the department, laboratory equipment; printed and hand-written materials (handouts) - authors Cantrak S., Lecic M. and Cocic A.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 28
laboratory exercises: 2
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 2
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 3
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 45
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 25

**references**

Fluid Mechanics B (handouts)
Hydraulics and pneumatics

**ID:** BSc-0347  
**teaching professor:** Лечић Р. Милан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** fluid mechanics  

**goals**

This course aims to teach students basic knowledge of hydraulics and pneumatics. First of all they need to learn to read schemes of hydraulic oil and pneumatic systems. In addition to this the audience of this course should be familiar with basic elements of all systems, with their functionality, place and role in hydraulic oil and pneumatic systems. Besides this, the aim of this course is to teach listeners the basics of calculations of elements, circuits and systems in general.

**learning outcomes**

The students listened to and passed this course will be able to read correctly each scheme of oil hydraulic or pneumatic system. In addition to understanding the scheme they will be able to accurately determine functionality of given system. Also, they will be able to independently calculate existing oil hydraulics and pneumatics systems in stationary regimes.

**theoretical teaching**


**practical teaching**


**prerequisite**

Passed examination of Fluid Mechanics B.
learning resources

Manuscript of lectures. Oil hydraulic components with section. Pneumatic installation for demonstration. Facility for testing the hydraulic characteristic of distributor.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 28
laboratory exercises: 2
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 10
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 70
requirements to take the exam (number of points): 20

references

Crnojevic C., Classical and oil hydraulic, Faculty of Mechanical Engineering University of Belgrade, 2006
general machine design

Fundamentals of machine design
Fundamentals of machine design
Fundamentals of product development
Machine Design
Machine Elements 1
Machine Elements 2
Machine elements 3
Machine elements failure analysis
Machine parts and constructions testing
Mechanical Engineering Praxis
Profesional training B - DUM
Shape Modelling
Skill Praxis B – MFB
goals

From the entire designers activity, here was separated only general significance - the basic design. It is being studied with the theoretical and practical aspects which gives the basic principles, methods and skills and thus develop a systematic and creative abilities of students. The matter in this subject is used further for design activities in each other specifically guidance.

learning outcomes

Basic principles of design, the analysis of design phases and application of standardization, unification and typing. Meeting the conditions necessary for the construction of the basic parameters, such as: shape, size, selection of appropriate materials, prescribing tolerance etc. Modern calculations of strength, stiffness, safety, reliability and service life. Rational use of the load capacity of material.

theoretical teaching

Introduction to design with necessary conditions: the function and purpose, working ability, productivity, economy, ecology, aesthetics, recycling. The methods of standardization, unification and typing in designing. Tolerances and measuring chains in design. Calculation methods of strength, deformation, stiffness, safety factor and reliability, increasing load capacity by applying the concept of local plastic deformation allowed. Fatigue treating of parts and structures material in the cases of constant and step variable stress and strain amplitude, and elasto-plastic deformation. Defining the shape of parts along the length and cross section. More rational use of load capacity of materials for savings in material and getting light structures.

practical teaching

Typing and measuring chains with instructions for the project. Calculation of static loaded parts. Calculation of elements with local plastic deformation concept at the uneven distribution of stress on the cross-section. The concentration of stress and strain, the calculation concepts of nominal and the actual stress at the notch root. Instructions for the project. Low and High cycle fatigue at constant amplitude and the hypothesis of accumulation of fatigue damage at step variable amplitudes - fatigue life. Instructions for the project. Lightweight structures. Examples of suitable technological shape in type and method for easy manufacture of parts.

prerequisite

Required: Attended and passed courses: Mechanical elements 1.
Desirable: Attended and passed the items of Mechanical Materials 2.

learning resources

Classrooms and laboratory with samples exposed machine parts and structures
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 8
seminar works: 0
project design: 5
consultations: 5
discussion and workshop: 2
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 55
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 10
final exam: 30
requirements to take the exam (number of points): 35

references

Orlov, P.I.: Fundamentals of machine design, Parts 1, 2, 3, 4, MIR Publisher, Moscow, 1976 - 77, in english.
Fundamentals of machine design

ID: BSc-0643

**teaching professor:** Ристовић Р. Милета

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** general machine design

**goals**

From the entire designers activity, here was separated only general significance - the basic design. It is being studied with the theoretical and practical aspects which gives the basic principles, methods and skills and thus develop a systematic and creative abilities of students. The matter in this subject is used further for design activities in each other specifically guidance.

**learning outcomes**

Basic principles of design, the analysis of design phases and application of standardization, unification and typing. Meeting the conditions necessary for the construction of the basic parameters, such as: shape, size, selection of appropriate materials, prescribing tolerance etc. Modern calculations of strength, stiffness, safety, reliability and service life. Rational use of the load capacity of material.

**theoretical teaching**

Introduction to design with necessary conditions: the function and purpose, working ability, productivity, economy, ecology, aesthetics, recycling. The methods of standardization, unification and typing in designing. Tolerances and measuring chains in design. Calculation methods of strength, deformation, stiffness, safety factor and reliability, increasing load capacity by applying the concept of local plastic deformation allowed. Fatigue treating of parts and structures material in the cases of constant and step variable stress and strain amplitude, and elasto-plastic deformation. Defining the shape of parts along the length and cross section. More rational use of load capacity of materials for savings in material and getting light structures.

**practical teaching**

Typing and measuring chains with instructions for the project. Calculation of static loaded parts. Calculation of elements with local plastic deformation concept at the uneven distribution of stress on the cross-section. The concentration of stress and strain, the calculation concepts of nominal and the actual stress at the notch root. Instructions for the project. Low and High cycle fatigue at constant amplitude and the hypothesis of accumulation of fatigue damage at step variable amplitudes - fatigue life. Instructions for the project. Lightweight structures. Examples of suitable technological shape in type and method for easy manufacture of parts

**prerequisite**

Required: Attended and passed courses: Mechanical elements 1.
Desirable: Attended and passed the items of Mechanical Materials 2.

**learning resources**

Laboratory of general machine design, University of Balgrade, Faulty of Mechanical
Engineering, Handouts, Presentations, Wireless Internet connection and access to the course Web presentation provided with usefull links.

**number of hours**

Total number of hours: 75

**active teaching (theoretical)**

Lectures: 20

**active teaching (practical)**

Auditory exercises: 30  
Laboratory exercises: 0  
Calculation tasks: 4  
Seminar works: 0  
Project design: 0  
Consultations: 4  
Discussion and workshop: 2  
Research: 0

**knowledge checks**

Check and assessment of calculation tasks: 2  
Check and assessment of lab reports: 0  
Check and assessment of seminar works: 0  
Check and assessment of projects: 0  
Colloquium, with assessment: 4  
Test, with assessment: 4  
Final exam: 5

**assessment of knowledge (maximum number of points - 100)**

Feedback during course study: 5  
Test/Colloquium: 60  
Laboratory exercises: 0  
Calculation tasks: 5  
Seminar works: 0  
Project design: 0  
Final exam: 30  
Requirements to take the exam (number of points): 35

**references**

S. Veriga: Machine elements 1, Faculty of Mechanical Engineering, Belgrade  
FME, in sebian  
Handouts
Fundamentals of product development

ID: BSc-0660

teaching professor: Огњановић Б. Милосав

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: general machine design

goals

Convict students that the product development is the base of economic prosperity of society. Development of science, technology and social sense push over existing products and depots necessity for development of the new. Except of learning of existing mechanical systems, design by coping and maintenance learning, engineers have to introduce and have ability for the new technical systems which are basically different comparing to existing ones. They have to introduce with methodology of knowledge transformation in technical systems. The objective of the subject is to involve students in thinking process in this direction.

learning outcomes

Student, future mechanical engineer, is realized necessity for the new product development, he is introduced with transformation process of knowledge into technical solution, with procedure of transformation, with fundamental postulates and effects of product realization. The areas of engineer creativity and effects are identified in relation with design coping of existing systems and learning to maintain these systems.

theoretical teaching

Introduction, product and new product definition; Product development process based at theory of technical systems; Presentation of product development in relation with development of society, science and technology in the course of history; Postulates for product development and prediction of product development in the future; Haw to find idea for the new product (searching for ideas); Functions and structure of technical systems; Biological systems transformation into technical solutions; Technical solution harmonization with surroundings in aesthetic and ecological sense; Elements of creativity in product development.

practical teaching

Seminar work which students have to work out in the course of semester contains processing of defined questions presented by lecture. These questions are also subject of discussion at the exercises with the aim to intake students into phenomena which it is necessary to work out in seminar work and also to prepare discussions for student’s knowledge check at colloquiums.

prerequisite

It is no conditions

learning resources

Power point presentations, lectures, case study presentations, books, Hand out.

number of hours

total number of hours: 75
active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 15
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 0
consultations: 0
discussion and workshop: 5
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 4
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 0
seminar works: 20
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

Pahl G., Beitz W.: Engineering Design - A Systematic Approach, - Springer Verlag
Hubka V., Eder E.: Theory of technical systems, / Springer Verlag
Frankenberger E., Badke-Schaube P., Birkhofer H.: Designers - The key to successful product development, - Springer Verlag
Machine Design

ID: BSc-0048

**teaching professor:** Огњановић Б. Милосав

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** oral

**parent department:** general machine design

**goals**

Introducing students to the procedure of synthesis of machine systems and then introducing with multidisciplinary approach combined of engineering design, industrial and aesthetic design. The development of creative abilities of students, learning methodologies and procedures for mechanical systems creation and the development of a personal sense for alignment of features (functional and aesthetic) with the environment, living and working environment.

**learning outcomes**

The student is introduced to the procedure of abstract thinking and generating ideas, developing new methodologies of principal and conceptual solutions. Trained to choose the parameters and dimensions of machine parts and systems, to choose and use of restrictions: functional, technological, aesthetic, ergonomic, and others. Trained to coordinate parameters of machine parts with the limits, developing the shape, dimensions, etc.

**theoretical teaching**

The mining of design (engineering and industrial), objectives, significance. Outlining the conceptual design (structure of functions, function carriers, conceptual solutions, selection of optimal solution). Selecting the machine parts design parameters (functions, forms and dimensions, material, production method). Choice of constraints (safety, reliability, level of vibration, noise,...). Suitability of machine part form for production by casting, forging, welding and machining. The benefit forms to sign. Aesthetic properties of machine parts and systems, harmonization of aesthetic features, the development of aesthetic features.

**practical teaching**

The mining of design (engineering and industrial), objectives, significance. Outlining the conceptual design (structure of functions, function carriers, conceptual solutions, selection of optimal solution). Selecting the machine parts design parameters (functions, forms and dimensions, material, production method). Choice of constraints (safety, reliability, level of vibration, noise,...). Suitability of machine part form for production by casting, forging, welding and machining. The benefit forms to sign. Aesthetic properties of machine parts and systems, harmonization of aesthetic features, the development of aesthetic features.

**prerequisite**


**learning resources**

2. Electronic materials: handouts, video clips, product photos, PP presentations - available for the subject teacher
3. Workstations (CAH), ICT, available in the laboratory 455 (TEMPUS)
4. 3D printer (CAH), ICT, available in the laboratory 455 (TEMPUS)
5. Software packages (CATIA, Fast prototyping) (CSP) - ICT, available in the laboratory, 455 (TEMPUS)

**number of hours**

Total number of hours: 75

**active teaching (theoretical)**

Lectures: 30

**active teaching (practical)**

Auditory exercises: 10
Laboratory exercises: 0
Calculation tasks: 9
Seminar works: 6
Project design: 0
Consultations: 5
Discussion and workshop: 0
Research: 0

**knowledge checks**

Check and assessment of calculation tasks: 2
Check and assessment of lab reports: 0
Check and assessment of seminar works: 2
Check and assessment of projects: 0
Colloquium, with assessment: 6
Test, with assessment: 0
Final exam: 5

**assessment of knowledge (maximum number of points - 100)**

Feedback during course study: 10
Test/Colloquium: 30
Laboratory exercises: 0
Calculation tasks: 20
Seminar works: 10
Project design: 0
Final exam: 30
Requirements to take the exam (number of points): 35

**references**

Ognjanović M.: Development and Design of machinery (theory, data, made examples) - Faculty of Mechanical Engineering Belgrade 2007
Pahl G., Beitz W.: Engineering Design - A systematic approach, - Springer Verlag
Hubka V., Eder E.: Theory of Technical Systems, - Springer - Verlag
Hubka V., Eder E.: Design Science, - Springer - Verlag
Haufe T: DESIGN, - DuMont Buchverlag
Machine Elements 1

ID: BSc-0045

**teaching professor:** Огњановић Б. Милосав

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** general machine design

**goals**

Introduce the students in solving of practical tasks in mechanical engineering. Teach students to understand components of mechanical systems, their functions, applications and variants of design solutions. Mastering the methods for calculation of operational safety, calculation of service life, and carrying capacity and also mastering the basics principles for machine elements design. Introduce the students to apply standards and other regulations in calculations and design of machine elements.

**learning outcomes**

The student has acquired knowledge of the basic components of mechanical systems - Machine elements. He acquired skill in determining the basic design parameters of machine elements (material, dimensions, tolerance, service stress, endurance limits, the level of safety, caring capacity, etc.). The student is trained to choose a standard machine parts and assemblies and to build them in the wither structure of the mechanical system. It was introduced into the question of development (fundaments of design) of new machine parts and machine elements. Trained to deal with practical issues in mechanical engineering.

**theoretical teaching**


**practical teaching**

Calculation of bolted thread joints, the choice of join type and calculation, calculation and design of screw power assemblies. Processing of project task, instructions for processing, monitoring and discussion with the students.

prerequisite

Defined by students curricula

learning resources

Books:
- M. Ognjanović.: Machine elements, Faculty of Mechanical Engineering, Belgrade 2008, 2011;
- S Veriga.: Machine elements (volumes I and II) , Faculty of Mechanical Engineering, Belgrade

Handouts available on the web site or reproduced on paper:
- Lectures, questions and tasks for colloquiums
- Guidelines for project tasks

Video presentation:
- Simulation of mechanical elements operation,
- Video presentation machine parts production and measurement
- Display of design solutions

laboratory:
- Show of machine elements, parts and components,
- Demonstration of machine elements testing
- Simulation of machine parts operation and production.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 6
laboratory exercises: 4
calculation tasks: 10
seminar works: 0
project design: 6
consultations: 4
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 4
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 2  
colloquium, with assessment: 4  
test, with assessment: 0  
final exam: 5

assessmemt of knowledge (maximum number of points - 100)
feedback during course study: 5  
test/colloquium: 30  
laboratory exercises: 0  
calculation tasks: 25  
seminar works: 0  
project design: 10  
final exam: 30  
requirements to take the exam (number of points): 35

references
Ognjanovic M: Machine elements, - Faculty of mechanical engineering, Belgrade 2006-2011  
Marek W., Muhs D, Wittel H., Becker M: Roloff/Matek Machinenelemente, - Friedr. Vieweg & Son Verlag, Braunschweig  
Decker : Machinenelemente - Cartl Hanser Verlag, Munchen.  
Shigley J.: Mechanical Engineering Design, - McGrow Hill  
Collins J: Mechanical Design of Machine Elements and Machines, - John Wiley and Sons
Machine Elements 2

ID: BSc-0046

teaching professor: Огњановић Б. Милосав

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: general machine design

goals

Introduce the students in solving of practical tasks in mechanical engineering. Teach students to understand components of mechanical systems, their functions, applications and variants of design solutions. Mastering the methods for calculation of operational safety, calculation of service life, and carrying capacity and also mastering the basics principles for machine elements design. Introduce the students to apply standards and other regulations in calculations and design of machine elements.

learning outcomes

The student has acquired knowledge of the basic components of mechanical systems - Machine elements. He acquired skill in determining the basic design parameters of machine elements (material, dimensions, tolerance, service stress, endurance limits, the level of safety, caring capacity, etc.). The student is trained to choose a standard machine parts and assemblies and to build them in the wither structure of the mechanical system. It was introduced into the question of development (fundaments of design) of new machine parts and machine elements. Trained to deal with practical issues in mechanical engineering.

theoretical teaching

Principles of mechanical power transformation, the basic equations of the transformation of mechanical power, transmission ratio and power transmission efficiency. Friction transmission units, the basic principles, performance, slip and wear in the contacts, materials of machine parts. Cylindrical gears (spur and helical), the basic principles of the teeth mashing, the geometry and kinematics of meshed gears. Strength and load capacity of cylindrical gears. Bevel and worm gears. Belt transmission pairs, load, stresses, service life. Chain transmission pairs. Couplings: rigid, flexible, knuckle, toothed, friction.

practical teaching

Determination of transmission ratios, torque, speed of rotation and power flows in gear structure, (power cabling in transmission unit). Calculation of gear teeth dimensions, gear dimensions, center distance, contact ratio etc. Strength (load capacity) of gears (spur, helical, bevel, worm). Calculation of belt transmission pairs geometry, loads, stresses, service life. Calculation of coupling load capacity. Display functions and design solutions, tests of strength and load capacity in the laboratory. Monitoring and instructing students to process project tasks.

prerequisite

Defined by students curricula

learning resources

Books:
M. Ognjanović.: Machine elements, Faculty of Mechanical Engineering, Belgrade 2008, 2011;
S Veriga.: Machine elements (volumes I and II), Faculty of Mechanical Engineering, Belgrade

Hendauti available on the web site or reproduced on paper:
- Lectures, questions and tasks for colloquiums
- Guidelines for project tasks

Video presentation:
- Simulation of mechanical elements operation,
- Video presentation machine parts production and measurement
- Display of design solutions

laboratory:
- Show of machine elements, parts and components,
- Demonstration of machine elements testing
- Simulation of machine parts operating and production.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 6
laboratory exercises: 4
calculation tasks: 10
seminar works: 0
project design: 6
consultations: 4
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 4
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 2
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 25
seminar works: 0
project design: 10
final exam: 30
requirements to take the exam (number of points): 35

references

Ognjanovic M: Machine elements, - Faculty of mechanical engineering, Belgrade, editions 2006-2011
Marek W., Muhs D, Wittel H., Becker M: Roloff/Matek Machinenelemente, - Friedr. Vieweg & Son Verlag, Braunschweig
Decker : Machinenelemente - Cartl Hanser Verlag, Munchen.
Shigley J.: Mechanical Engineering Design, - McGrow Hill
Collins J: Mechanical Design of Machine Elements and Machines, - John Wiley and Sons
Machine elements 3

**ID:** BSc-0424  
**teaching professor:** Јанковић Д. Миодраг  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** general machine design

**goals**

Completion and upgrade of the problems discussed in the obligatory subjects Machine elements 1 and 2. The objectives are: a more detailed and accurate calculations of strength, safety and load capacity of machine parts, in general and the specific mechanical elements contained in the present case, in particular. Their use enables the students to run their project tasks with increased reliability and safety.

**learning outcomes**

Overall rounded and complete introduction to the whole problem in the previous two obligatory and this optional, elected subjects. Mastering the fundamental basis calculations of the working ability of machine parts and more complex structures using the operating conditions by means of knowledge from several disciplines. In that way the students are trained for more quality solutions of both general and more complex problems.

**theoretical teaching**

First, based on previously acquired knowledge from several obligatory subjects (Mechanical engineering materials, Resistance of materials, Machine elements 1 and 2), as well as complement in this necessary field, students study the more detailed calculations of strength, safety, load capacity and life of machine elements which are presented only particular or in reduced extent in the subjects Machine elements 1 and 2. On this basis, the issues which was only partial and insufficient considered in the program of Machine elements 1 and 2, are studied at a higher level. This continues further with the study of machine parts and elements that are not enough considered in these two subjects, such as: elastic elements - springs, pipes and pressure vessels, their linking and joints with other relevant elements, as flanged connections and sealing compounds. As a special inseparable joints are considered such as welded, riveted, soldered and adhesive joints.

**practical teaching**

Supplemented calculations examples of increased load capacity and determining the safety factor by static and dynamic loads. More detailed calculations in the region of low and high cycle fatigue at constant and stepped changing of stress and strain amplitudes and the determination of useful fatigue life. Application of these calculations to the specific machine elements contained in this subject, such as: piping, pressure vessels and their connections, flange sealing elements, elastic elements - springs, and discussed examples of mechanical joints. Project tasks with instructions for preparation.

**prerequisite**

Attended and passed courses: Machine elements 1 and Mechanical materials 1 and 2; attending the subject: Machine elements 2.
learning resources

Classroom and laboratory with exposed specimens of machine parts and constructions.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 8
seminar works: 0
project design: 5
consultations: 5
discussion and workshop: 2
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 55
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 10
final exam: 30
requirements to take the exam (number of points): 35

references

Machine elements failure analysis

ID: BSc-0636

**teaching professor:** Лазовић М. Татјана
**level of studies:** B.Sc. (undergraduate) academic studies
**ECTS credits:** 6
**final exam:** oral
**parent department:** general machine design

**goals**

1. Achieving basic knowledge on machine elements failure analysis based on application of design principles, analytical procedures, numerical tools, appropriate measuring techniques and diagnostic methods.
2. Understanding dominant machine elements failure (MEF) modes in terms of design and operational conditions.
3. Mastering the basics of analytical and empirical procedures for identifying MEF.
4. Mastering the basics of practical problems solving (MEF prediction and prevention, elimination of their causes and consequences).

**learning outcomes**

At the end of the course student should be able to:

1. define and classify types of machine elements failures,
2. to connect causes of machine element failure with properties of its design, application and operational conditions
3. to make a proper choice of means and methods of machine elements failure diagnostics,
4. to propose measures to prevent machine elements failures,
5. to make appropriate report on analyzed machine element failure.

**theoretical teaching**


**practical teaching**


**prerequisite**

Recommended: attended classes of Machine elements 1 and Machine elements 2

**learning resources**
Suggested literature includes the necessary material for lectures, exercises and laboratory work. Required additional material (handouts and instructions for laboratory exercises) is given at the web site or as hard copy. Large electronic materials can be available to students in direct contact. Lectures and exercises are carried out using a blackboard and/or video. Laboratory exercises are carried out in the Machine elements laboratory.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 15
laboratory exercises: 9
calculation tasks: 4
seminar works: 0
project design: 0
consultations: 5
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 60
laboratory exercises: 5
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

**references**

Ognjanovic, M.: Masinski elementi, Masinski fakultet Beograd
Mitrovic, R.: Klizni i kotrljajni lezaji, Masinski fakultet Beograd
Veriga, S.: Masinski elementi (I, II, III), Masinski fakultet Beograd

Appropriate literature, available at lecturer office
Machine parts and constructions testing

**ID:** BSc-0047  
**teaching professor:** Ристивојевић Р. Милета  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** general machine design

**goals**

Acquiring basic knowledge in the field testing of machine parts and structures. Mastering the test methods and devices for testing in static and dynamic conditions. The forming of skills for solving practical problems. Developing the ability to connect knowledge and skills in various fields. Developing skills for simple experimental investigations.

**learning outcomes**

Developing skills for laboratory work for testing of machine parts and construction: selection of methods and devices for appropriate test type; presentation and analysis of results; determination the dynamic load of machine parts based on dynamic load of the standard model; determination the life of mechanical structures based on the hypothesis of linear accumulation of damage.

**theoretical teaching**


**practical teaching**

Introduction with devices and apparatus for machine parts and structures testing. The basic principles of data acquisition based on the application of personal computers. Example of LabVIEW development tools for the realization of applications of virtual instruments. Introduction with various forms of destruction and damage of machine parts made in the static and dynamic conditions. Determining the service life of mechanical parts based on the hypothesis of linear accumulation of damage. Determination of static and dynamic characteristics of machine parts based on static and dynamic characteristics of the standard model - the specimens or etalon model (etalon bolt, etalon gear set). Autonomous work of computational tasks.

**prerequisite**

**Required**  
Attended and passed exams: Machine elements 1, Machine elements 2

**Desirable**  
Attended and passed exams: Mathematic 1, 2 and 3
learning resources

General Machine Design Laboratory

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 17
laboratory exercises: 6
calculation tasks: 6
seminar works: 0
project design: 0
consultations: 1
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 2
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 50
laboratory exercises: 0
calculation tasks: 15
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

Lecture separats
Mechanical Engineering Praxis

ID: BSc-0714
teaching professor: Милош В. Марко
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 5
final exam: written
parent department: general machine design

goals

Introduction of the students about all mechanical fields which are the subject of studying in Mechanical faculty from the point of view of practical work in each particular field: Control Engineering, Biomedical engineering, Naval architecture, Aerospace engineering, Design in mechanical engineering, Railway mechanical engineering, Welding and welded structures, Engineering of biotechnical systems, Industrial engineering, Information technologies, Motor vehicles, Internal combustion engines, Food industry engineering, Production engineering, Process engineering and environment protection, Weapon systems, Thermal power engineering, Material handling, constructions and logistics, Thermal science engineering, Hydropower engineering, Computational Engineering

learning outcomes

The students will be introduced about practical work in all fields which are the subject of studying in Mechanical faculty.

theoretical teaching

Presentation of the any particular field - study module at Mechanical faculty.

practical teaching

prerequisite

learning resources

number of hours

total number of hours: 29

active teaching (theoretical)

lectures: 29

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks
check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 0

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 90
requirements to take the exam (number of points): 0

**references**

professor's handouts
Profesional training B - DUM

ID: BSc-0482

teaching professor: Огњановић Б. Милосав

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 1

final exam: seminar works

parent department: general machine design

goals

Introducing the field of product development and design, particularly in terms of practical applications in mechanical engineering (functional, aesthetic, technological, market). Identifying the basic functions of design and its importance in product development, market competence and also in harmonization of technical solutions with environment. Consideration of the technological aspects of product development in mechanical engineering.

learning outcomes

Practical experience in identifying characteristics of the product in mechanical engineering, functional, technological and aesthetic. Recognition of technology for realization of products, technologies for the development of functional properties and technologies for the development of aesthetic properties. Recognition of market and social needs for products. Recognition of the product life cycle phases in mechanical engineering: the development and design, technology implementation, operation and recycling.

theoretical teaching

Introduction, objectives and content of activities.

practical teaching

Practical work includes professional visits to organizations involved in development and design of products, organizations involved in technology implementation (design) in mechanical engineering and organizations involved in distributing these products to market. These may be organizations for aesthetic design of products (industrial design), for engineering design of products, production and trade organizations of products in mechanical engineering. Professional training can be done abroad. During practice the student keeps a diary, containing a description of operations performed, observations and conclusions. Following the training creates a report that defends the subject teacher. The report is submitted in the form of seminar work.

prerequisite

It is no conditions.

learning resources

Organizations that contain the whole product life cycle, development, manufacture, use.
- Organizations involved in product development.
- Industrial enterprises whose activities are manufacture of products in mechanical engineering.
- Industrial companies whose business is based on the use of mechanical systems
- Companies whose business is distribution and maintenance of machines and components.

number of hours

167
total number of hours: 46

active teaching (theoretical)

lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

-
Shape Modelling

ID: BSc-0088
teaching professor: Маринковић Б. Александар
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: general machine design

goals

The aim is to introduce students to the understanding of space and geometric forms in 3D environment. Intention is also understanding the topology types of machine parts, such as methodology of forming a 3D model as a starting point for the development of forms of machine parts and assemblies. Learning and exercising of procedures and tools developed for manipulating forms, parameter changes and optimum shape to achieve optimal solutions in machine design modeling.

learning outcomes

The student is trained to create all kinds of model forms of machine parts using CATIA software. It is completely trained to parametrically vary the shape and form parts, to optimize the form and combine them to compose the assembly. Student has acquired knowledge that the application of CATIA tool optimizes the shape and adjust the properties of this form. The student is also familiar with basics of using modules for simulation and structural analysis.

theoretical teaching


practical teaching


prerequisite

Required: Attended and passed the Engineering Graphics, Computer Tools
Preferred: Attended and passed the Machine Elements 1 and Machine Elements 2

learning resources

book "Shape Modeling" A.Marinković, M.Stanković, Mechanical Engineering Faculty 2011.;
other literature for CATIA V5 software;
hand-outs of lessons;
equipment available in room 455, 3D printer and computers;
CAD working station, CAD software tool CATIA V5

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 15
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 10
consultations: 5
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 30
requirements to take the exam (number of points): 35

**references**

Shape modeling - lessons and exercises , (preparing for print), A.Marinković, M.Stanković
Documentation and Users Manual for CATIA V5
Skill Praxis B – MFB

**ID:** BSc-0715  
**teaching professor:** Милош В. Марко  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 1  
**final exam:** seminar works  
**parent department:** general machine design

**goals**

Practical experience in ambient similar to the ambient where the graduated student - mechanical engineer will realize his own professional carrier. Recognizing the basic functioning of the business systems especially in domain of development, design and manufacturing of the mechanical systems.

**learning outcomes**

Students can reach practical experiences about the organization and functioning the business systems that deal in mechanical engineering. Student may be introduced in business communication, design processes, development processes and manufacturing.

**theoretical teaching**

**practical teaching**

The skill praxis is organized in a way which is the most appropriate for the student. Practical work must be realized in the company where the mechanical engineering is the primary occupation. What the student will work, see or follow must be defined in coordination with the professor. Generally, student can realize practical work in: manufacturing companies, design companies, companies which work maintenance in mechanics or in laboratories that belong to the Mechanical faculty. After finishing the practical work, the student must prepare the Report and this Report needs to be defended in front of professor

**prerequisite**

**learning resources**

Initial resources are laboratories that belong to the Mechanical faculty.

**number of hours**

total number of hours: 46

**active teaching (theoretical)**

lectures: 0

**active teaching (practical)**

auditory exercises: 0  
laboratory exercises: 0  
calculation tasks: 0  
seminar works: 46
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 100
project design: 0
final exam: 0
requirements to take the exam (number of points): 0

references
hydropower engineering

Basic of Turbomachinery
Practical work
Practical work
Pumps and fans
Basic of Turbomachinery

ID: BSc-0050  
teaching professor: Гајић Ђ. Александар  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 6  
final exam: oral  
parent department: hydropower engineering

goals

1. Introduction of theoretical knowledge of fluid flow in turbomachinery.  
2. Studying of energy and exploitation characteristics of turbomachinery and their application in mechanical systems.  
3. Obtaining of practical skills application of pumps and fans in power systems.

learning outcomes

1. Gaining basic knowledge about the exchange of energy in turbomachinery.  
2. Reaching the methods of choice of turbomachinery according to the energy system.  
3. Understanding the control and the energy efficiency of turbomachinery.  
4. Obtaining practical experience of turbomachinery exploitation.

theoretical teaching

1. The principles of energy exchange in turbomachinery, the theoretical basis of thermodynamic and fluid mechanics. Viscous and non viscous fluid-flow through the turbine runners and pump impellers. Energy balance in the turbomachines and impellers. Absolute and relative fluid flow in turbomachinery impellers and runners. Phenomena in fluid flow in turbomachinery.  
2. Characteristics of different type of turbomachinery: pumps, fans, compressors, hydraulic turbines and hydraulic torque convertors. Use of these machines in urban and industrial water supply systems, ventilation systems, process industry, public and industrial transportation and other energy systems. Energy and cavitation characteristics of pumps and water turbines and compliance with the systems characteristics. Control of turbomachinery.

practical teaching

Visits to the waterworks and ventilation systems in order to introduce the work of turbomachines. Laboratory exercises: the behavior of pumps and fans in different working regimes. Calculation of specific hydraulic energy of pumps, fans and compressors. Verification of cavitation characteristics of pumps and hydraulic systems. Specific hydraulic energy of the runner and impeller and turbomachinery efficiency. The laws of similarity and dimensionless characteristics. Laboratory tests on energy parameters of pumps or fans. Representation of dimensional and dimensionless characteristics of these turbomachines. Introduction to the ventilation and pumping facilities. Forms and types of impellers and fluid flow. Undesirable effects and damages in turbomachinery.

prerequisite

Passing Exams: Introduction to Energy, Fluid Mechanics

learning resources

Lectures in written and partially in electronic form, written exercises, practical examples of the
numerical calculations, computer support.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 17  
laboratory exercises: 2  
calculation tasks: 3  
seminar works: 0  
project design: 0  
consultations: 3  
discussion and workshop: 5  
research: 0

**knowledge checks**

check and assessment of calculation tasks: 6  
check and assessment of lab reports: 0  
check and assessment of seminar works: 0  
check and assessment of projects: 0  
colloquium, with assessment: 4  
test, with assessment: 0  
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10  
test/colloquium: 40  
laboratory exercises: 10  
calculation tasks: 10  
seminar works: 0  
project design: 0  
final exam: 30  
requirements to take the exam (number of points): 30

**references**


Gajic A., Pejovic S., Turbomachinery - Illustrative and Test Exams, Faculty of Mechanical Engineering, Belgrade 1993.
Practical work

**ID:** BSc-0084  
**teaching professor:** Бенишек Х. Мирослав  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 1  
**final exam:** seminar works  
**parent department:** hydropower engineering

**goals**

The goal of professional practice is that students in addition to theoretical work within subjects at the faculty get to know and experience the jobs in factories, institutes, laboratories and similar commercial enterprises and thereby gain insight into the activities to be performed. During the practice, students must keep a diary in which they enter a description of the tasks performed, and write down their conclusions and observations. Following the practice, students must write a report that is to be discussed about with the subject teacher.

**learning outcomes**

Observing the work practices a student acquires special knowledge of specific business enterprises, production facilities, public services and utilities and the like, so their theoretical knowledge can be applied to specific business practice. It is essential to acquire and develop a talent for communication and insight into professional ethics. Also the student has the ability to meet professional experts from whom they will get a good picture of how their knowledge can be usefully applied.

**theoretical teaching**

The course content is practical work, which consists of spending working time in certain organizations that perform various activities in mechanical engineering. The choice of a theme as well as a business or research organization is made in consultation with the concerned teacher. Students may perform their practice in: design and energy consulting profession organizations, organizations that produce and maintain power equipment, organizations that build and maintain power plants, power plants, waterworks companies and laboratories of the Department of hydraulic machines and power systems.

**practical teaching**

In the design and consultancy organizations, students are introduced to the process of design and analysis of power plants, acquire practical knowledge of engineering graphics, use of modern computer programs for designing and analyzing equipment and facilities, implementation of measures for rational use of energy and environmental protection and others. In organizations that produce and maintain power equipment they are acquainted with the process of equipment production, technological lines of production, quality control, and others. Within the companies for the construction and maintenance of power plants they acquire knowledge about the organization of construction, layout of equipment and technological systems in plants, and others. In power plants they get to know the appropriate processes, technology systems, fixtures and equipment, methods, process analysis, measurement of process parameters, operating the plant, and others. In the laboratories of the Department of Energy hydropower systems they can become familiar with the available equipment and measuring equipment.

**prerequisite**
Desirable knowledge in Constructive geometry, Engineering graphics (AutoCAD, Catia, and similar software programs).

**learning resources**

[1] Instructions for writing reports from professional practice, available in the library of the Faculty of Mechanical Engineering Belgrade (MFB),
[2] Guidelines for handling the equipment and facilities in the laboratories of the Department,
[3] Installation for testing the energy and cavitation features of turbine models, small hydropower plants and hydromechanical equipment, available in the laboratory of HEN,
[4] Installation for flow meter calibration by volume method, available in the laboratory of HEN

**number of hours**

total number of hours: 46

**active teaching (theoretical)**

lectures: 0

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

**references**
Practical work

ID: BSc-0623  
**teaching professor:** Гајић Ђ. Александар  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 1  
**final exam:** seminar works  
**parent department:** hydropower engineering

**goals**

The goal of professional practice is that students in addition to theoretical work within subjects at the faculty get to know and experience the jobs in factories, institutes, laboratories and similar commercial enterprises and thereby gain insight into the activities to be performed. During the practice, students must keep a diary in which they enter a description of the tasks performed, and write down their conclusions and observations. Following the practice, students must write a report that is to be discussed about with the subject teacher.

**learning outcomes**

Observing the work practices a student acquires special knowledge of specific business enterprises, production facilities, public services and utilities and the like, so their theoretical knowledge can be applied to specific business practice. It is essential to acquire and develop a talent for communication and insight into professional ethics. Also the student has the ability to meet professional experts from whom they will get a good picture of how their knowledge can be usefully applied.

**theoretical teaching**

The course content is practical work, which consists of spending working time in certain organizations that perform various activities in mechanical engineering. The choice of a theme as well as a business or research organization is made in consultation with the concerned teacher. Students may perform their practice in: design and energy consulting profession organizations, organizations that produce and maintain power equipment, organizations that build and maintain power plants, power plants, waterworks companies and laboratories of the Department of hydraulic machines and power systems.

**practical teaching**

In the design and consultancy organizations, students are introduced to the process of design and analysis of power plants, acquire practical knowledge of engineering graphics, use of modern computer programs for designing and analyzing equipment and facilities, implementation of measures for rational use of energy and environmental protection and others. In organizations that produce and maintain power equipment they are acquainted with the process of equipment production, technological lines of production, quality control, and others. Within the companies for the construction and maintenance of power plants they acquire knowledge about the organization of construction, layout of equipment and technological systems in plants, and others. In power plants they get to know the appropriate processes, technology systems, fixtures and equipment, methods, process analysis, measurement of process parameters, operating the plant, and others. In the laboratories of the Department of Energy hydropower systems they can become familiar with the available equipment and measuring equipment.

**prerequisite**
Desirable knowledge in Constructive geometry, Engineering graphics (AutoCAD, Catia, and similar software programs).

learning resources

[1] Instructions for writing reports from professional practice, available in the library of the Faculty of Mechanical Engineering Belgrade (MFB),
[2] Guidelines for handling the equipment and facilities in the laboratories of the Department,
[3] Installation for testing the energy and cavitation features of turbine models, small hydropower plants and hydromechanical equipment, available in the laboratory of HEN,
[4] Installation for flow meter calibration by volume method, available in the laboratory of HEN

number of hours

total number of hours: 46

active teaching (theoretical)

lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
Pumps and fans

ID: BSc-0442

*teaching professor:* Недељковић С. Милош

*level of studies:* B.Sc. (undergraduate) academic studies

*ECTS credits:* 6

*final exam:* written

*parent department:* hydropower engineering

**goals**

Mastering knowledge of engineering applications of pumps and fans as machines for raising of fluid energy. Capacity to work in practice on energy installations, as well as design of installations that include a pump or blower as a built-in element with its function.

**learning outcomes**

Knowledge of types and designs of pumps and fans. Knowledge of the energy parameters and energy balancing. Knowledge of similarity theory to implement the dimensionless parameters - characteristic performance factors. Knowledge of methods of the system working point determination. Knowledge of the energy characteristics of pumps/fans and their significance in establishment of operating regimes of pumps/fans, as well as in their regulation. Knowledge of the pump cavitation characteristics and operating characteristics change for fans working with density other than air.

**theoretical teaching**


**practical teaching**


**prerequisite**

Knowledge of fluid mechanics. It is desirable that the student has passed the examination of the subject Introduction to Energy Engineering.
learning resources

Handouts for the exercises.
Laboratory for hydraulic machines - equipment, installations, measuring equipment.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 26
laboratory exercises: 2
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 10
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 70
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 21

references
industrial engineering

Business Management
Business Production Information Systems
Engineering economic analysis
English 1
English 2
Fundamentals of Sociology and Economics
Industrial Engineering Professional Practice B
Industrial ergonomics
Introduction to Industrial Engineering
Maintenance management
Management of Production Processes
Production and Operations Management 1
Business Management

ID: BSc-0039

teaching professor: Покрајац У. Слободан

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: industrial engineering

goals

The focus of analysis is the enterprise as production system, with complex internal and external environment. By simulation of realization of business ideas, the individual performances of every student will be shown. The aims of this module is that students get know basic principles of the business in conditions of increasing competition both on local and international markets.

learning outcomes

By get knowing of the content of Business Management the student will get know all the most important challenges, internal and external environment and other important conditions for own business undertaking. The higher level of knowledge and skills, as well as entrepreneurial features and competences necessary for successful leading of business, are expected. Writing of business plans is the opportunity to check to ability of potential entrepreneurs.

theoretical teaching


practical teaching

Practical work is consisted of auditory work, i.e. discussions and workshops with additional selected themas, as well as characteristic cases from local and international experiences. Special attention will be paid to the analysis of processes of growing innovations, especially technological one, as a factor of competition. Because of that, the focus will be on new tools, such as knowledge management, reengineering, outsourcing, benchmarking, etc. Also, practical work is used for preparing individual and group seminar works and preparing business plans.

prerequisite

At least 50 points, when completed and defensed business plan will be specially valorised.

learning resources

Beside the cited literature, the other sources, such as selected internet links, handout, or prepared work cases, both the local and international praxis, will be used.
Slobodan Pokrajac, Dragica Tomić, Entrepreneurship, (in Serbian), Alfa-graf, Novi Sad, 2008

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 0
consultations: 10
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 5
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 20
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 0
final exam: 30
requirements to take the exam (number of points): 50

**references**
Business Production Information Systems

**ID:** BSc-0412  
**teaching professor:** Милановић Д. Драган  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** industrial engineering

**goals**

Acquisition of knowledge for applying computers in business-production systems, so as to carry out computerization of all information flows in the system and in the system-environment interaction. Within the framework of such approach, attention is directed to information systems design. Also, the aim is to master specific, highly professional skills of using specialized software tools for business-production systems management. Decision-making support systems and expert systems are studied.

**learning outcomes**

The student develops the following abilities: understanding the place and role of information systems in business-production systems, design of information systems, scanning and analysis of the existing information flows and critical perception of their advantages and deficiencies. Acquisition of knowledge needed for application in solving problems of production-business systems.

**theoretical teaching**


**practical teaching**

Task 1) In a concrete enterprise, by applying CCA methodology, design data flow diagram. In accordance with specificities of the observed production process, choose the appropriate information system and discuss it. Choose software and hardware system for a selected preliminary solution. Task 2) Using the example from production practice, develop the decision-making support system that will help decision-makers/managers solve a concrete problem. Task 3) Using the example from production practice, develop an expert system by applying expert system empty shell. Develop a database of rules, interface, and explain the application of the designed expert system in practice.

**prerequisite**

There are no prerequisites.

**learning resources**

Computer room. Software packages: Decision-making support system and Expert system shell.
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 15
calculation tasks: 0
seminar works: 0
project design: 10
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 10
final exam: 30
requirements to take the exam (number of points): 30

references

D.D. Milanovic, M.Misita, Information systems for decision-making and management support. FME, Belgrade, /In Serbian/ 2008.
Engineering economic analysis

ID: BSc-0592

teaching professor: Милановић Љ. Драган

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: industrial engineering

goals

Training students to be able to make timely and optimal business decisions, of which directly depend on the overall business results achieved. Most important decisions are taken based on the foregoing analysis and tests of overall conditions and results of their implementation, so it is necessary to introduce students to different models of analysis for the implementation of successful business management.

learning outcomes

Mastering this program, student obtains the following general skills: analysis and synthesis and forecasting solutions and consequences; mastery of methods, procedures and processes of research; application of knowledge in practice.

He also obtains the following subject-specific skills: solving practical problems using scientific methods and procedures, linking basic knowledge in various fields and their applications.

theoretical teaching


practical teaching

Practical training consists of seminar tasks of the above teaching units and solving computing problems. It is necessary to be done 5 computational exercises and 3 seminary papers.

Computational tasks are from: the analysis of demand and supply function, the revenue function, the cost function and the elasticity of demand, revenue and costs, linear and nonlinear regression and the time series analysis. Seminary papers are from the following scientific fields: production function, average function, marginal function and substitution of production factors, optimal volume of production and system of demand functions.

prerequisite

The student must be enrolled in second year (the third semester).

learning resources

1. Handouts;
2. Dubonjic R, Milanovic Lj D: Engineering Economy, Publishing Centre of Industrial
Management Plus, Krusevac, 2005. (in Serbian)
3. Backovic M, Vuleta J: Economic-mathematical methods and models, EF, Belgrade, 2004 (in Serbian);
4. Mladenovic Z, Petrovic P: Introduction to Econometrics, Belgrade, 2003 (in Serbian);

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 8
laboratory exercises: 0
calculation tasks: 16
seminar works: 0
project design: 0
consultations: 6
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 4
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 6
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 35
laboratory exercises: 0
calculation tasks: 30
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

**references**

Milicevic V, Ilic B: Economics of Enterprise - focus on modern business, Faculty of Organizational Sciences, Belgrade, 2005 (in Serbian);
Milicevic V: Strategic business planning - management approach, Faculty of Organizational Sciences, Belgrade, 2007 (in Serbian);
Mladenovic Z: Collection of solved tasks in econometrics, Faculty of Economics, Belgrade, 2002 (in Serbian);
English 1

ID: BSc-0506

teaching professor: Весић Павловић С. Тијана

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 2

final exam: written

parent department: industrial engineering

goals

Achieving competence in oral and written communication by acquiring an appropriate level of active knowledge of English. Training students to use vocational literature in order to master the disciplines of their future profession and be able to follow their development in the world, as well as to use the knowledge of English for equal participation and accomplishment of contacts on the professional level.

learning outcomes

Development of skills for active usage of the language in the situations of professional and business communication. Expanding and enriching the usage of vocational terminology and vocational vocabulary in general in oral and written form (abstracts, summaries, business letter), improving oral expression; acquisition and mastering of skills of using grammar structures characteristic for vocational language.

theoretical teaching

Thematic units in the field of physics and engineering materials, i.e. the fields studied at the faculty, but presented in a new medium – the English language. Vocational terminology, words familiar from general language with semi-technical and technical meanings. Structures characteristic for vocational language: definitions, generalisations, classifications. Practicing the acquired grammar knowledge with special emphasis on the constructions characteristic for functional language: relative clause reduction, passive, syntactic structures. Acquainting students with differences in formal and informal written communication. and training them for business correspondence in English.

practical teaching

Speaking models, writing and speaking exercises, textual, audio and video recordings. Individual, group and pair work used in practice classes. Special emphasis on practicing the linguistic skill of understanding by reading and listening. Exercises also include writing simple abstracts, summaries, preparation of short oral presentations. Further, practicing the usage of the most frequent linguistic constructions in vocational language. Writing short formal and informal letters (asking for and providing information, applying for participation at professional conferences, room reservations at hotels etc.).

prerequisite

Defined by the curriculum of the study programme/module.

learning resources

number of hours

total number of hours: 30

active teaching (theoretical)

lectures: 12

active teaching (practical)

auditory exercises: 12
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 1

assessment of knowledge (maximum number of points - 100)

feedback during course study: 40
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 40

references

English 2

ID:  BSc-0489

**teaching professor:** Весић Павловић С. Тијана

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 2

**final exam:** written

**parent department:** industrial engineering

**goals**

Achieving competence in oral and written communication by acquiring a certain level of active knowledge of English. Training students to use vocational literature in order to master the disciplines of their future profession and be able to follow their development in the world, as well as to use the knowledge of English for equal participation and accomplishment of contacts on the professional level.

**learning outcomes**

Development of skills for active usage of the language in the situations of professional and business communication. Expanding and enriching the usage of vocational terminology and vocational vocabulary in general in oral and written form (abstracts, summaries, business letter), improving oral expression; acquisition and mastering of skills of using grammar structures characteristic for vocational language.

**theoretical teaching**

Thematic units in the field of machine elements, machinery and engines, i.e. the fields studied at the faculty, but presented in a new medium – the English language. Vocational terminology, words familiar from general language with semi-technical and technical meanings. Structures characteristic for vocational language: definitions, generalisations, classifications. Practicing the acquired grammar knowledge with special emphasis on the constructions characteristic for functional language: relative clause reduction, passive, syntactic structures. Acquainting students with differences in formal and informal written communication, and training them for business correspondence in English.

**practical teaching**

Speaking models, writing and speaking exercises, textual, audio and video recordings. Individual, group and pair work used in practice classes. Special emphasis on practicing the linguistic skill of understanding by reading and listening. Exercises also include writing simple abstracts, summaries, preparation of short oral presentations. Further, practicing the usage of the most frequent linguistic constructions in vocational language. Writing short formal and informal letters (asking for and providing information, applying for participation at professional conferences, room reservations at hotels etc.).

**prerequisite**

Defined by the curriculum of the study programme/module.

**learning resources**

number of hours

total number of hours: 30

active teaching (theoretical)

lectures: 12

active teaching (practical)

auditory exercises: 12
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 1

assessment of knowledge (maximum number of points - 100)

feedback during course study: 40
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 40

references

Fundamentals of Sociology and Economics

ID: BSc-0405

teaching professor: Покрајац У. Слободан

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 4

final exam: written

parent department: industrial engineering

goals

The aim of this subject is that students get know basic principles of fundamental social science, sociology and economics, and become able to understand the most important appearances and processes in modern societies, especially in societies within globalization. The aim is to more competencies for self and responsible taking part in processes of professional and public decisions.

Topics covered in this course include sociology as science, culture, socialization, social groups, social organization, education, deviance, crime, class, inequality, race and ethnicity, gender, family, social change, technology and population. The course stresses the learned nature of human behavior as a shared product of the ongoing interaction of individuals and groups within the changing institutional structure we call society.

Also, topics in Economics presents basic concepts and theories in many areas of contemporary economy. Topics covered in this class include key aspects of micro and macroeconomics.

learning outcomes

By adopting of the programme of this course the students strengthen their own abilities to understand critically the most important controversies of development of all modern societies, especially of transitional ones, such as ours. Modern theoretical concepts and empirical methods are of special importance.

The module covers the themes of social integration, power, social change, the individual and society, as well as examining the social and economic basis of culture, beliefs, consciousness and general social development.

theoretical teaching


practical teaching

The practical work (exercise) is consisted of discussions and workshops with additionally chosen themes relevant from theoretical as well as practical point of view. The point out will be on sociological and economic analysis of modern societies, comparing to the others analytical and methodological procedures. Characteristic cases from the experience of development of our society in ongoing transition and globalization will be analyzed. Also, this part will be used for consultations for preparation and defense of seminar works.
prerequisite

At least 50 points, when the most important are the points from practical exams.

learning resources

Cited literature, handouts and the power-point presentations. Also, internet addresses, other literature according to the professor’s recommendation, especially for seminar works presentations are important.

Slobodan Pokrajac, Nikola Dondur, Introduction to Economics, (in Serbian), Proleter, Bečej, 2009

number of hours

total number of hours: 45

active teaching (theoretical)

lectures: 18

active teaching (practical)

auditory exercises: 9
laboratory exercises: 0
calculation tasks: 0
seminar works: 4
project design: 0
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 2
check and assessment of projects: 0
colloquium, with assessment: 2
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 20
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 0
final exam: 30
requirements to take the exam (number of points): 50

references
Industrial Engineering Professional Practice B

ID: BSc-0587

**teaching professor:** Мисита Ж. Мирјана

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 1

**final exam:** written

**parent department:** industrial engineering

**goals**

The aim of this course is introduction of students to the production processes and to acquire practical knowledge in the field of work organization in industrial enterprises. After taking this course, students will be familiar with the tasks of diagnosis and improvement the overall organization in the enterprises. Methods and techniques the students learn will be useful in everyday tasks of mechanical engineers.

**learning outcomes**

By course mastering, the students get familiar with:
1. production processes in the enterprise, 2. internal transport, 3. terotechnological process 4. function of production planning, 5. the supply and storage of materials and others.

**theoretical teaching**

Theoretical classes: The role and importance of professional practice - Industrial Engineering. Organization of visits to the factories of metal processing complex in Belgrade, where the students will obtain the necessary knowledge and practical skills in the field of planning and organization of production processes. Students will get a theoretical background in the field of the following disciplines: 1. organization of production processes in the enterprise, 2. internal transport, 3. terotechnological process, 4. functions of production planning, 5. supply and storage of materials and others.

**practical teaching**


**prerequisite**

Enrolled 4th semester of undergraduate studies.

**learning resources**

As part of professional practice, it is necessary to arrange a visit to industrial enterprises. Students should record the state of the manufacturing process and obtain product
documentation that will be shown in the report of professional practice.

**number of hours**

total number of hours: 46

**active teaching (theoretical)**

lectures: 0

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 30
project design: 0
final exam: 0
requirements to take the exam (number of points): 30

**references**

Bulat, V., 1999, Organization of production, FME, Belgrade, /In Serbian/
T.Jovanovic, D.D.Milanovic, Spasojevic, V., 1996, Contemporary organization and management of production, FME, Belgrade, /In Serbian/
Industrial ergonomics

ID: BSc-0075
teaching professor: Жуњић Г. Александар
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: industrial engineering

goals

The aim of this course is the acquisition of basic academic knowledge in the field of industrial ergonomics, which can be used for designing, evaluation and improvement of system man-machine-environment. Students should acquire specific practical skills that include an integrated ergonomic approach for the purpose of a comprehensive settlement of various engineering problems.

learning outcomes

By mastering of industrial ergonomics program, the student acquires the ability to solve all aspects of the various engineering problems by applying science-based ergonomic methods, techniques and recommendations. It is expected that acquired knowledge students can use in daily work and practice, bearing in mind that in almost all branches of industry there is a need for designing, which includes the human factor.

theoretical teaching


practical teaching

Laboratory exercise: Evaluation of changable noise - here are presented the criteria and procedure for assessing of the harmful effects of noise and performs an estimation of harmful effects of noise in the selected workplace. Laboratory exercise: Assessment of physical work effort - here are presented the criteria and procedure for assessing physical effort during the work, and the work that is performed in laboratory conditions is an object of estimation. Making of project - Assessment of usability of software / web presentation. Writing of a seminar paper - Each student selects one of a number of topics, for which he is writing seminar paper in the form of professional work.

prerequisite

Necessary condition for attending the course is that the student have enrolled to the appropriate semester.

learning resources
Žunjić A. and Ćulić M., 2007, Practicum for laboratory exercises in industrial ergonomics, Faculty of Mechanical engineering, Belgrade - available in the bookstore and library of the Faculty of Mechanical Engineering. Klarin M. and Žunjić A., 2007, Industrial ergonomics, textbook, Faculty of Mechanical engineering, Belgrade - available in the bookstore and library of the Faculty of Mechanical Engineering. Fonometer - available in the lab. 417. CAD working station, available in the lab. 455. Software package Ergoeaser, available in the lab. 455.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 12
calculation tasks: 0
seminar works: 5
project design: 4
consultations: 4
discussion and workshop: 5
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 2
check and assessment of projects: 4
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 20
calculation tasks: 0
seminar works: 20
project design: 20
final exam: 30
requirements to take the exam (number of points): 40

**references**

Introduction to Industrial Engineering

ID: BSc-0209

**teaching professor:** Милановић Д. Драган

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** industrial engineering

**goals**

Acquisition of knowledge for successful management of enterprises. Apart from necessary theoretical knowledge, concepts, methods and techniques for solving some practical problems in the area of industrial engineering are studied.

**learning outcomes**

Thorough knowledge and understanding of the scientific area of industrial engineering. Solving concrete problems by using methods and techniques of industrial engineering. Linking basic knowledge from various areas and its application. Development of communication skills and cooperation with the environment. Use of information technologies to master knowledge of the appropriate area.

**theoretical teaching**


**practical teaching**

Exercises are realized through carrying out a project task that consists of three parts. Prior to assigning the project task, each student is given instructions and explanations, with a printed text. Project tasks consist in written and graphic presentation of teaching units theoretically presented during lectures, which are of crucial importance for industrial engineering. A set of presented units makes up a project assessed at the end by a final grade that is taken into account at final exam. The subject matter of tasks focuses on the application and check of knowledge acquired during lectures, through solving real problems that occur in production.

**prerequisite**

No special prerequisites. The semester in which this Course is attended must be certified.

**learning resources**

Apart from literature recommended, printed materials can be found on the Faculty's website.
They contain the contents of units presented at lectures and instructions for project task. Use of the Internet is desirable to improve the quality of project task and final exam.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 7
laboratory exercises: 0
calculation tasks: 6
seminar works: 0
project design: 12
consultations: 5
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 5
seminar works: 0
project design: 15
final exam: 30
requirements to take the exam (number of points): 20

**references**

Vuksan B, Organization of production, FME, Belgrade, 1999 /In Serbian/
T.Jovanovic, D.D.Milanovic, V.Spasojevic, Contemporary organization and management of production, FME, Belgrade,1996 /In Serbian/
Maintenance management

ID: BSc-0414

**teaching professor:** Бугарић С. Угљеша

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** industrial engineering

**goals**

Perception of position and cost of maintenance within life cycle of technical systems. Acquaint ion with parameters which affect design of maintenance organization. Practical determination and analyze of technical system reliability. Acquaint ion with standard malfunctions, methods for condition monitoring as well as with equipment for condition monitoring. Overwhelm with methods for determination of replacement and reparation strategies, maintenance costs and inventory optimization. Acquaint ion with possibilities of maintenance system optimization and application of computer systems – business solutions.

**learning outcomes**

Curriculum overcome enables overwhelm with necessary knowledge and skills (models, optimization procedures, monitoring and measure equipment, basics of computer systems – business solutions) for implementation in maintenance organizations of complex technical systems.

**theoretical teaching**


**practical teaching**


Seminar work (Analysis of gathered data about malfunction on real system, determination of malfunction intensity, determination of probability density function of time until malfunction, using chi-square test.).

Laboratory work (Acquaint ion with standard and advanced equipment for system condition monitoring - SKF, as well as with possibilities of implementation of maintenance module in company computer systems – business solutions - Siemens).

**prerequisite**
There is no special conditions needed for course attending

**learning resources**

7. Practical instruction in industrial environment (SKF, Siemens).
8. Mobile devices for measurement of temperature and vibrations.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 15
laboratory exercises: 10
calculation tasks: 0
seminar works: 5
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 3
check and assessment of seminar works: 1
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 10
calculation tasks: 0
seminar works: 10
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references

Management of Production Processes

**ID:** BSc-0561  
**teaching professor:** Мисита Ж. Мирјана  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** industrial engineering

**goals**

The aim of this course is to familiarize students with the basic characteristics of production processes, with special emphasis on small production companies. The first goal is formation and planning of the production process for a product through theoretical and practical preparation. Another objective of the course is theoretical and practical familiarization of students with the basic characteristics of enterprises functioning with respect to all elements related to production processes.

**learning outcomes**

After passing the course students should: be able to perceive the complexity and characteristics of production processes, to identify problems that may arise at the production processes and to be able to propose appropriate solutions for its improvement. Also after passing this course, students should be able for team work.

**theoretical teaching**

The theoretical part of this course: the first part introduces students to the organizational structures related to production processes, recursive process of forming a new product. Process of forming the material component, with single-level, hierarchical, technological and temporal formation of components, with a budget of progressive work. Resources needed to produce one product in terms of available facilities, manpower and time available. Duration of the production cycle. In the second part of this course the focus is placed on the operation of manufacturing processes by defining the highlights of their placement, type and characteristics. Special attention was paid to the manner of manipulation and management and monitoring material flow through production processes and methods and characteristics of material storage, raw materials and products.

**practical teaching**

Practical part of this subject includes team work in groups of three students. Students choose a product that will produce, define its characteristics, form a component of the material, technological and operational component. The production of a specific series is formed on the basis of the limits set in the volume of production and factory capacity and available manpower. Students visit the factory and warehouse in order to see real practice problems. Laboratory exercises follow the discussion on the lessons.

**prerequisite**

Enrolled the fourth semester of undergraduate studies.

**learning resources**

Electronic form of highlights from lectures and exercises will be available to the students.
There will also be shown the appropriate contemporary models and applications on computers.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 6
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 14
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 3
colloquium, with assessment: 0
test, with assessment: 7
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 25
final exam: 30
requirements to take the exam (number of points): 31

**references**

Bulat V., 1999, Organization of production, FME, Belgrade /In Serbian/
Salvendy G., 2001, Handbook of Industrial Engineering, John Wiley & Sons, Canada
Production and Operations Management 1

ID: BSc-0602

**teaching professor**: Спасојевић-Бркић К. Весна

**level of studies**: B.Sc. (undergraduate) academic studies

**ECTS credits**: 6

**final exam**: written

**parent department**: industrial engineering

**goals**

The aim of this course is to acquire knowledge and practical skills in the field of theory and practice of the production management. Mechanical engineers after taking this course are trained to perform diagnostics and to apply methods for raising the general level of enterprise organization and rationalization of operations and production. Methods and techniques for production and operations management are useful in everyday tasks of mechanical engineers.

**learning outcomes**

Upon successful completion of this course, student acquires the following professional skills and are able for: 1. Diagnosing the state of the organization of the company, 2. Organizational structure design, 3. Rationalization of production and operations processes in the company and 4. Analysis of the success rate of an enterprise. After completion of the course students also demonstrate an awareness and an appreciation of the importance of the operations and production management to the sustainability of an enterprise and are trained to use methods and techniques of production and operations management.

**theoretical teaching**


**practical teaching**

Design of Macro-organizational structure of manufacturing enterprises with particular emphasis on the organizational structure of the production function micro level. Solution of practical problems in the areas of linear programming, network planning - CPM, inventory management and capacities calculations and production cycle time measurement. The corporate performance measures calculation.

**prerequisite**

Students need to enroll 5th semester.

**learning resources**

Bulat V., Organization of production, Faculty of Mechanical Engineering, Belgrade, 1999.
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 1
laboratory exercises: 0
calculation tasks: 6
seminar works: 0
project design: 18
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 3
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 4
colloquium, with assessment: 2
test, with assessment: 1
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 15
seminar works: 0
project design: 20
final exam: 30
requirements to take the exam (number of points): 30

references
Bulat V., Organization of production, Faculty of Mechanical Engineering, Belgrade, 1999. (in Serbian)
Jovanovic T., Milanovic D. D., V Spasojevic., Modern organization and management, Faculty of Mechanical Engineering, Belgrade, 1996. (in Serbian)
Klarin M., Industrial Engineering, Volume 1, The organization and planning of production processes, Faculty of Mechanical Engineering, Belgrade, 1996. (in Serbian)
information technologies

Basic WEB projecting
Database Design
Engineering communication
Informational Integration of Business Functions
Information integration of business functions
Practical training B-MIT
Software engineering 1
WEB projecting in mechanical engineering
Basic WEB projecting

ID: BSc-0432

teaching professor: Митровић Б. Часлав

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: project design

parent department: information technologies

goals

Course objective:

• To acquaint students with the importance and benefits of Web and Web programming.
• To make students adopt some of the methodologies of data preparation for Web
• To make students know the basic Web application to accept and display the data.
• The creation, introduction and use of the Web Site
• Determining the functionality of your own web site

learning outcomes

The acquired knowledge allows students:

• to prepare, make and display their own skills,
• to determine the functionality of the Web site,
• to prepare and implement Web applications,
• to prepare and implement a simple Web site,
• working in a team, prepare and implement any Web site.

theoretical teaching

WEB ARCHITECTURE (Internet–Web; specific Web application, basics of HTTP, WAP protocol) LANGUAGE HTML, XML.
Basics OF JAVA Java abstract layer; (Java servlets and Java applets, network protocols)
PROGRAMMING ON THE USER (hierarchy, event and timing component management; introduction to ASP)
USING database (JDBC, PHP, ASP, transaction models, distributed computing, CORBA, RMI, DCOM)
PREPARATION OF WEB DOCUMENTS (legal terms, the control input, testing, authoring tools according to W3C; criteria)
WEB DESIGN (planning, implementation, design of Web pages; typography, editorial style, graphics, graphic file formats, image maps, multimedia)
Intelligent agents. SAFETY (introduction, architecture, ways of implementation, application, security on the Web; Wessex protocols, identification and verification)
DESIGN PRESENTATION AVAILABLE TO INVALIDS (various disabilities, visual, auditory, motor and cognitive disabilities, limitations and instructions)

practical teaching

Analysis of Web sites on the Internet. Determining the optimal Web site. Definition of personal presentation. Making personal presentations and set up and run on a local server. Discussion on advantages and disadvantages of the used tools. Posting remarks on the network to other authors of presentation. Compiling all the presentations and making the home page. Selecting editor to write the code. Creating personal Web site. Formatting documents in HTML.
Formation of the list.; Creating hyperlinks, addressing, use of images, forming tables (Table);
frames or zone (frame); creating forms. Selecting the best tool for Web applications. Individual work tasks using HTML, XML, XHTML, JavaScript and Java. Preparation for the project of team working on Web site. Analysis of the goals, objectives and anticipating problems that may occur in the preparation of Web site. Defining the profile and requirements. Presentation plan. Model of presentation. Realization of experimental Web Site.

prerequisite

'defined by curriculum of study program / modules'

learning resources

To successfully master the subject, it is necessary the use of textbooks, manuals for the project, handouts, Internet resources. IT equipment (appropriate hardware and software) ICT, available in the laboratory 457)

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 20

active teaching (practical)

auditory exercises: 6
laboratory exercises: 21
calculation tasks: 0
seminar works: 7
project design: 3
consultations: 0
discussion and workshop: 3
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 5
check and assessment of projects: 2
colloquium, with assessment: 0
test, with assessment: 3
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 30
laboratory exercises: 5
calculation tasks: 0
seminar works: 20
project design: 20
final exam: 20
requirements to take the exam (number of points): 35
references

Database Design

ID: BSc-0259

teaching professor: Радојевић Љ. Слободан

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: project design

parent department: information technologies

goals

Course objective:
• Analysis of problems in the creation of a set, data collection, database.
• Step-by-step accepting the methodology of logical and physical design and the database.
• Analysis of selected problems typical for company business.
• Accurate and clear introduction to the DBMS and SQL.

learning outcomes

The achieved knowledge allows:

• identified the real object data that becomes information,
• obtained data at the basic level get systematized and logical prepar,
• logical data prepared at the basic level get copied to database,
• obtain informations from existing database using a higher level base of SQL.

theoretical teaching

The development of software systems is teamwork (starting and iterative development, business requirements).
The modeling and design (physical and logical model; objects - entities and business functions).
Design from implementation to the realisation (charts, diagrams and business functions, database designer).
Business modeling and design (the chart; activities related to business function, visualization).
For the definition of requirements (alignment with the requirements of users; stages of life of a software system).
Analysis and design of the (overlapping analysis, design and implementation; class diagram; meeting the demands of business functions).
Models for design (profiles, unstandard diagrams).
The physical realization (local or distributed nature of database, DBMS, linking of data included in the database).
UML in the design (using UML and applications, modeling and design stages and monitoring constructs, evaluations of the project).

practical teaching

Practical work is based on case studies. It also fully complies with the theoretical teaching.
Laboratory exercises are used for monitoring of seminar papers and final project.

prerequisite

Preferred:
Communication engineering.
Information integration of business functions.
learning resources

The necessary software for this case under the GNU license. If you use LINUX necessary UML immediately available. If you use another operating system UML can be downloaded from the appropriate Web site (see URL of cases) or in the URL in the case. To run the software necessary to possess enough simplest PC.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 20

active teaching (practical)

auditory exercises: 6
laboratory exercises: 20
calculation tasks: 0
seminar works: 4
project design: 10
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 5
check and assessment of projects: 3
colloquium, with assessment: 0
test, with assessment: 2
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 5
laboratory exercises: 0
calculation tasks: 0
seminar works: 60
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references
Engineering communication

ID: BSc-0384
teaching professor: Бенгин Ч. Александар
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: project design
parent department: information technologies

goals

- Understanding the importance and gaining ground skills in the preparation and execution of communication with different customers (management, professional services, colleagues and clients).
- Introduction to the creation, presentation and use of engineering documentation. Computer processing of documentation
- Identifying the basic functional units in companies, and learning about mutual communication these entities.
- Understanding the basic documents that characterize the activities of companies. Preparation for the Computer processing of these documents.

learning outcomes

The acquired knowledge enables listener:
- to prepare, create and display their own skills.
- to prepare, make and present a report on the accomplished work.
- to prepare, perform and manage the presentation, discussion.
- to recognize the basic functional units of the company, and to notice interdependent.
- to recognize the basic documentation of the company, and
- to prepare the basic documentation for computer processing.

theoretical teaching

Communication (oral and written; parameters, the application of computers in communication).
Organizing communication (structure and content; defining, evaluating and managing information, organizing ideas and facts).
The speech (voice and body language, audience and management issues, and managing a set of discussion).
Engineering documentation (contracts, offers, CV, bills, invoices, technological documentation, reports).
The company as a generator of information (organizational units of small and medium enterprises; supplies; norms, accounting).
On some documents (inventories, stock lists, card material). Enterprises; supplies; norms, accounting).
A coding system (definition and enforcement, bar code, the parallel coding system, application in the supply).
BOM (modular, hierarchical, two-level, generic bill explosion, obtaining bill explosion).
Archive, send, protect documentation (copies, storage place, send the documentation; encryption).
About presentation (collection, processing, selection of information, organization and planning of the presentation).

practical teaching
Practical exercises consist of learning about the creation of technical documentation and
documents for communication. It is also used appropriate software. Development of two
projects CV and presentation of a problem with topic on information technology are the
essence of practical training.

prerequisite

learning resources

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 20

active teaching (practical)

auditory exercises: 6
laboratory exercises: 16
calculation tasks: 0
seminar works: 5
project design: 10
consultations: 0
discussion and workshop: 3
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 2
check and assessment of projects: 5
colloquium, with assessment: 0
test, with assessment: 3
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 15
laboratory exercises: 15
calculation tasks: 0
seminar works: 15
project design: 20
final exam: 30
requirements to take the exam (number of points): 35

references
Informational Integration of Business Functions

ID: BSc-0076

**teaching professor:** Спасић А. Жарко

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** information technologies

**goals**


**learning outcomes**


**theoretical teaching**


**practical teaching**


**prerequisite**

Defined in the curriculum of study program/module.

**learning resources**

Spasić, Ž. et al., Faculty of Mechanical Engineering, University of Belgrade - The mission of the
Faculty of Mechanical Engineering: Alumni Fund of Faculty of Mechanical Engineering - αMEβ, Editors Ž. Spasić et al. The first Alumni Congress, 2005.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 8
calculation tasks: 4
seminar works: 6
project design: 10
consultations: 2
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 1
check and assessment of lab reports: 1
check and assessment of seminar works: 2
check and assessment of projects: 2
colloquium, with assessment: 2
test, with assessment: 2
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 15
laboratory exercises: 10
calculation tasks: 10
seminar works: 10
project design: 10
final exam: 40
requirements to take the exam (number of points): 36

**references**
Information integration of business functions

ID: BSc-0614

**teaching professor:** Митровић Б. Часлав

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** information technologies

**goals**

- Design and management of digital integrated business companies / factory, according to the business performance of integrated company,
- Acquiring knowledge, skills and competencies of the information and functional integration of the company,  
- Integration of engineering, production and business activities
- Learn about the business performance of integrated company,
- Training to use commercial software for production management,
- Implementation of new information and communication technologies.

**learning outcomes**

The acquired knowledge to the student:

- Understand the operation of an integrated business enterprise / factory,
- Applies new information and communication technology,
- Critically observe production systems and business processes,
- Plans computerized activities, processes and systems,
- Approves new methods of learning and design,
- Develop cognitive traits of creative engineers in computer science,
- Participates in project teams of students and experts
- Is able to conduct business discussions with business partners.

**theoretical teaching**

Lesson 1
- Model information and functional integration of the company.
- Model reference CIMOS ESPRIT's open architecture information and communication systems.

Lesson 2
- The cybernetic definition of a business system.
- The cybernetic definition of business processes and business domains.

Lesson 3
- Theory for designing integrated digital company / factory.
- CIMOS functional entities and the transfer of information across levels of business.

Lesson 4
- Modeling for enterprise integration and a digital description of the business.
- Modeling of educational and business environment is an integrated enterprise.

Lesson 5
- Engineering database / knowledge and standard interfaces.
- Design of technical systems, products and technologies.
- The documentation and electronic exchange of information.
Lesson 6
• Management of supply chain information integration with business partners.
• Optimal flow through the business sectors and facilities.
• Management and storage of materials throughout.

Lesson 7
• Information flow and integrated business tools.
• Flexible cell technology, systems and production facilities.
• Integrated maintenance and diagnostics.

Lesson 8
• An integrated system of quality assurance.
• Allocation of available resources.
• Multi-criterion decision-making.
• Procedures for quality.
• Quality standards.

Lesson
• Technology innovation in business.
• Engineering and re-engineering of business processes and systems.
• Management costs.
• Information and communication infrastructure is an integrated enterprise.

10th Chapter
• The development and life cycle of the business system.
• Business performance intelligent digital business enterprises.
• The business profile and marketing companies / industries.
• Analysis of the results (outcomes) of learning objects.
• Preparation and instructions for the exam.

practical teaching
It consists of the auditory, laboratory exercises that accompany the course.
• Information integration of production and business enterprises.
• Systems for managing computer-integrated company activities.
• Business profile production companies.
• Information and functional integration of business enterprises.
• Students carry out professional training in an industry of Serbia or the professional excursion abroad.

prerequisite
• unconditionally previously passed exams.

learning resources
• Students are available to licensed software owned by the faculty.
• Students are available freeware software.
• Student must have a PC simplest configuration.

number of hours
• total number of hours: 75
active teaching (theoretical)

lectures: 20

active teaching (practical)

auditory exercises: 2
laboratory exercises: 8
calculation tasks: 6
seminar works: 8
project design: 10
consultations: 4
discussion and workshop: 2
research: 0

knowledge checks

check and assessment of calculation tasks: 1
check and assessment of lab reports: 1
check and assessment of seminar works: 2
check and assessment of projects: 2
colloquium, with assessment: 2
test, with assessment: 2
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 15
laboratory exercises: 10
calculation tasks: 10
seminar works: 10
project design: 15
final exam: 35
requirements to take the exam (number of points): 35

references

Spasic, Ž., Information integration of business functions, Book, Mechanical Engineering, Belgrade
Practical training B-MIT

ID: BSc-0364  
**teaching professor:** Митровић Б. Часлав  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 1  
**final exam:** seminar works  
**parent department:** information technologies

**goals**

To provide students with practical experience of staying in an environment in which the student will realize his future career. Identifying the basic functions of information systems in the field of design, development and production software, as well as roles and tasks of mechanical engineering of information technology in such a business system.

**learning outcomes**

Training students to apply previously acquired theoretical and practical engineering and scientific knowledge of information technology to solve specific practical engineering problems in the selected companies or Institutions. Activities to introduce students to selected companies or institutions, the manner of operation, management and engineering position and role of IT in their organizational structures.

**theoretical teaching**

MIT provides students with practical training by working with reputable companies and scientific research institutions of Serbia in the IT sector. Practical form for each candidate separately, in agreement with the management companies or research institutions that provide services in professional practice, and in accordance with the development of new information technologies from which the student has previously acquired theoretical knowledge.

**practical teaching**

Practical work consists of student involvement in the process of the enterprise or research institutions, consulting and writing daily professional practice in which a student describes the activities and tasks performed by the expert during the practice.

**prerequisite**

Required: Basic IT knowledge. Prior knowledge acquired in previous modules listened MIT courses.

**learning resources**

Lectures for MIT courses modules that can be downloaded from the FTP server module MIT: ftp://mit.mas.bg.ac.rs

**number of hours**

**total number of hours:** 46  
**active teaching (theoretical)**  
lectures: 0
active teaching (practical)

auditory exercises: 0
laboratory exercises: 42
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 4

assessment of knowledge (maximum number of points - 100)

feedback during course study: 60
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 20
project design: 0
final exam: 20
requirements to take the exam (number of points): 35

references
Software engineering 1

ID: BSc-0529
teaching professor: Митровић Б. Часлав
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: information technologies

goals

• Acquisition of basic skills in the preparation of projects related to software development are important for small and medium-sized companies.
• Using some simple CASE tool for the design of some parts of the software.
• The acquisition of skills which overcome the barriers to collaboration in teams to write and implement software.

learning outcomes

• to participate in the software team as a team member with special knowledge related to mechanical engineering,
• to notice problems in the design and determine the problematic processes that can influence and some numerical mark on the project,
• to prepare all the necessary data for modeling of certain parts of the software,
• to prepare valid documentation for software,
• to participate in the implementation of the software with the contractor.

theoretical teaching

About software engineering, models and modeling (introduction, model theory, sketches of model ...; numerical parameters of model).
Costs, prices and use the software (price, role of engineers and engineering, hardware and software, software with errors, types of software bugs).
The organization of software projects (people, team development; individual roles; productivity and the impact on productivity, types of software projects, organization of software companies).
Modeling of software development and processes (Pert; relationship with the client; different types of modeling and software development, process definition, classification process, process management).
The documentation, software quality and metrics (goal; possibilities of electronic documents; standards for documentation, managing and documenting software defects and errors, audit software).
Software for software development (special tools for developing GUI application components; code generators, and some examples of the application).
Analysis, specification and drafting software (applications, data collection and processing, internal standards for the collection and processing of applications; importance of sketching and drafting software).
Coding, testing and integration of software (the programming language, coding, editors; way of testing software, software integration and software integration strategy, expected and unexpected problems in integration of software).
Configuring and reliability of software (software configuration; special features of the software).
Re-engineering and reuse of software (software evolution in all aspects of the project).

practical teaching
Practical classes:
It consists of laboratory exercises that accompany the objects, and continuous monitoring of the project through the creation of the final four seminar papers.

prerequisite
Preferred: Web design in mechanical engineering, database design as well as objects defined curriculum of study program / modules

learning resources
To cope with the case, it is necessary the use of textbooks, manuals for the project, a handout, Internet resources. IT equipment (hardware and software appropriate) ICT, available in the laboratory 457).

number of hours
total number of hours: 75

active teaching (theoretical)
lectures: 20

active teaching (practical)
auditory exercises: 6
laboratory exercises: 20
calculation tasks: 0
seminar works: 3
project design: 8
consultations: 0
discussion and workshop: 3
research: 0

knowledge checks
check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 2
check and assessment of projects: 3
colloquium, with assessment: 3
test, with assessment: 2
final exam: 5

assessment of knowledge (maximum number of points - 100)
feedback during course study: 5
test/colloquium: 15
laboratory exercises: 15
calculation tasks: 0
seminar works: 15
project design: 20
final exam: 30
requirements to take the exam (number of points): 35
references
WEB projecting in mechanical engineering

**ID:** BSc-0070

**teaching professor:** Митровић Б. Часлав

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** project design

**parent department:** information technologies

**goals**

**Course objective**

• Understand the importance of Web sites in Mechanical Engineering,
• The creation, introduction and use of Web projects,
• Determining the functionality of Web projects,
• Preparing your own Web projects,
• Understanding and preparing the necessary documentation for the implementation of Web projects in Mechanical Engineering

**learning outcomes**

The acquired knowledge allows the:

• prepare, make and display your own skills,
• determine the functionality of all the specifications on the Web,
• prepare, perform and manage the designing of Web presentations,
• determine the technology of designing Web sites,
• recognize the requirements of the local machinery industry for Web presentations,
• create a necessary documentation of Web project,
• implement and collect Web project.

**theoretical teaching**

EVOLUTION OF THE SITE (customize and manage information in real time, Web services protocols, distributed applications, (in) compatibility of older protocols)

DOMAIN (generic and territorial domain, and the choice of the name, subdomains)

Web Design (theme, technology and design web site, templates, navigation, HomePage, content and readability of Web page; redesigned Web)

WEB SITE DESIGN (Web competition, testing and checking the Web)

CREATING AND PROGRAMMING Web - A (HTML, XML, XHTML, XSLT, CSS, HTAs)

CREATING AND PROGRAMMING Web - B (Java Script, Java)

CREATING AND PROGRAMMING Web - C (SQL, Server Side Scripting, Web services)

Web elements (tools and readers, Free Hosting, HTTP compression, and client-server setup, HTTP messages and warnings)

DESIGNING WEB SERVICES (life cycle of Web, development, analysis, technology and tools)

Web Development Presentation (price, vision, technology, design, price list, installation, maintenance and promotion of the website)

**practical teaching**

Search for existing patterns of web presentation, specific to mechanical engineering Joomla. Technology of Web design, web site creation layout pattern. Analysis whit defined rules of navigation, the navigation, rules for creating a Web page and the proper approach to the formation of introductions - Home Page. Problems with readability and refresh Website

**prerequisite**

Preferred: Basic Web design and engineering communication as well as objects defined curriculum of study program / modules’

**learning resources**

To cope with the case, it is necessary the use of textbooks, manuals for the project, a handout, Internet resources. IT equipment (hardware and software appropriate) ICT, available in the laboratory 457).

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 20

**active teaching (practical)**

auditory exercises: 6
laboratory exercises: 21
calculation tasks: 0
seminar works: 7
project design: 3
consultations: 0
discussion and workshop: 3
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 5
check and assessment of projects: 2
colloquium, with assessment: 0
test, with assessment: 3
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 20
laboratory exercises: 5
calculation tasks: 0
seminar works: 20
project design: 20
final exam: 30
requirements to take the exam (number of points): 35

references
internal combustion engines

Automotive engines design - introduction
Diagnostic and Maintenance of IC Engines
Digital data acquisition and virtual instrumentaion
Engineering Practice Bsc - IC Engines
Engineering Practice Bsc - IC Engines
Exploitation and overhaul of engines
Hybride Powertrain Systems
Industrial Compressors
Industrial Compressors
Internal combustion engines
Operation and overhaul of engines
Reciprocating Compressors
Automotive engines design - introduction

ID: BSc-0621

teaching professor: Томић В. Мирољуб
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: internal combustion engines

goals

The course enables the insight in engine working process fundamentals, engines types and classification and design of main engine elements and engine systems for fuel supply, cooling and lubrication. The course is indented for the students of IC engines group giving them the fundamentals for later more comprehensive study of engine design, and also for the students of other groups where basic knowledge of engine design is required.

learning outcomes

Acquired theoretical and practical knowledge of the design of engine parts and systems train the students for practice in engine exploitation and maintenance in all technical field of engine application. Gained knowledge is the basic for deeper study during further Msc degree schooling with the aim to train the students for complex problems of the designing of engine parts, systems and the whole engines.

theoretical teaching

1. IC engine working process principles; spark ignition and diesel; four stroke and two stroke process
2. IC engines classification and types; design specifics in various fields of engine application.
3. Design of engine stationary parts; downer and upper engine case, engine block and cylinder liner; cylinder head.
4. Design of main engine moving parts; piston assembly – piston, piston rings, piston pin; design of connecting rod and crankshaft.
5. Design of engine gas exchange system.
6. Design of engine cooling system - liquid and air cooling.
7. Design of engine lubricating system.
8. Design of engine starting system.

practical teaching

3. Design of engine cooling and lubricating systems; evaluation of required capacity of engine cooling and lubricating systems.

b) Laboratory exercises: 1. Display of engine parts design, various engine types and engine systems.
2. Visit to engine factory – the tour through design department and producing and assembling lines.
3. Disassembling and assembling of spark ignition engine.
4. Disassembling and assembling of diesel engine.

prerequisite

No prerequisites required.

learning resources

2. M.Tomić: IC engines design fundamentals – handouts, available in PDF format in IC engines
department.
3. Sections of the engines. Various parts of the engines. Complete engines prepared for
disassembling and assembling.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 9
laboratory exercises: 16
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 5
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 6
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

**references**

M.C. Živković, R. Trifunović: Internal combustion engines, part 2. Engine design 2, Design and
Van Basshuysen, R., Schafer, F. (Editors): Internal Combustion Engine Handbook: Basics,
7680-1139-5
A. Kolchin, V. Demidov: Design of automotive engines, English translation, Mir Publishers
Moscow, 1984.
Diagnostic and Maintenance of IC Engines

ID: BSc-0226
teaching professor: Цветић Р. Милош
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: internal combustion engines

goals


learning outcomes


theoretical teaching


practical teaching

a) Classroom sessions: numerical examples. Preparation for laboratory sessions.
b) Laboratory sessions: 1. Influence of adjustable engine systems parameters on engine operation and characteristics (fuel consumption, exhaust emissions). 2. Review and analysis of typical engine parts and sub-assemblies failures and damages. 3. Visit of representative engine service shop.

prerequisite

Mandatory: passed exam Internal combustion engines fundamentals. For MSc studies - IC Engines module - passed exam Engine Working Processes.

learning resources

Trifunović, R: Engine operation, 1st part, Faculty of Mechanical Engineering, Belgrade, 1983. (in serbian). Handouts (PDF files). Instructions to carry out laboratory sessions (PDF files). Numerical examples (PDF files). Test beds for IC engines testing, measuring equipment and data acquisition software, Center for IC engines.

number of hours
total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 8
laboratory exercises: 5
calculation tasks: 12
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 5
research: 0

**knowledge checks**

check and assessment of calculation tasks: 4
check and assessment of lab reports: 2
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 4
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 20
laboratory exercises: 15
calculation tasks: 20
seminar works: 0
project design: 0
final exam: 45
requirements to take the exam (number of points): 30

**references**

Digital data acquisition and virtual instrumenataion

ID: BSc-0367  
teaching professor: Цветић Р. Милош  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 6  
final exam: written  
parent department: internal combustion engines

goals

The aim of the course is to provide comprehensive insight into the digital acquisition systems (DAQ) and, mainly, their usage in the field of testing of systems covered in the Mechanical Engineering; To introduce students the world of virtual instrumentation and graphical programming environment (LabVIEW) which is dedicated to development of DAQ applications. To gain experience on functioning and using DAQ systems through numerous, real world, examples. To get closer acquaintance with the sensors, and digital acquisition software & hardware, in general, and methods of DACQ software developing and testing.

learning outcomes

Ability to integrate sensors and DAQ hardware in measurement chain in order to fulfill specific requirements in the field of mechanical engineering system testing & measurements. Ability to build and test software application (LabVIEW virtual instruments) for measurement and automation of various mechanical engineering systems. Practical knowledge in computer based measurements of fundamental engineering data

theoretical teaching

Architecture and basic principles of data acquisitions systems (DAQS); Definition and clarification of the fundamental terms in the field of measurement technique. Using FFT signal analysis; Fundamentals of signal filtering (Analog & Digital); Hardware components of the DAQ module –DAQ device; Basic principles of digital data acquisition; Temperature sensors and signal conditioning; Sensors of speed, force, acceleration and signal conditioning; Specific issues on digital input/output of DAQ devices; Counters and their usage for counting of discrete events and position measurement; Frequency/Period measurement of the digital signal by means of counters; Communications standards in measurement instrumentation (RS-232, RS-422/485, IEEE-488 (GPIB));

practical teaching

Introduction to the Virtual Instrumentation (VI) and LabVIEW development environment; Data flow in VI; Troubleshooting and Debugging Vis; Implementing a VI; Managing Hardware resources (Low and High-Level File I/O ); Common Design Techniques and Patterns; Synchronization Techniques; Event Programming; Error Handling; Controlling the User Interface (VI Server Architecture; Control references); File I/O Techniques ; Improving an Existing VI; Creating and Distributing Applications; Student Project: Building a DAQ with given requirements;

*)National Instruments (NI) Labview courses “Core 1” & “Core 2” are incorporated in the theoretical and practical teaching of this course. This course is in compliance with the “LabVIEW Academia” program and therefore offers students all benefits stated in LabVIEW Academia agreement.
prerequisite

No particular requirements for attending this course

learning resources

Handouts: N. Miljić, Computer Based Measurements & Virtual Instrumentation
DACQs: National Instruments USB 6008, MyDAQ, PXI, ...
Graphical Development Environment: National Instruments LabView 2010 with modules and toolkits (LVA package)
Auxiliary platforms: Demo board for simulation of analog and digital signals; Universal Amplifying / Conditioning board for various sensors; Driver board for DC and step motors

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 18

active teaching (practical)

auditory exercises: 22
laboratory exercises: 19
calculation tasks: 0
seminar works: 0
project design: 3
consultations: 0
discussion and workshop: 1
research: 0

knowledge checks

check and assessment of calculation tasks: 4
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 3
colloquium, with assessment: 0
test, with assessment: 3
final exam: 2

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 45
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 15
final exam: 30
requirements to take the exam (number of points): 42

references
Labview Core 1 & 2 Course Manual & Exercises, National Instruments
Engineering Practice Bsc - IC Engines

**ID:** BSc-0698

**teaching professor:** Томић В. Мирољуб

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 1

**final exam:** seminar works

**parent department:** internal combustion engines

**goals**

Students will be acquainted with technological and manufacturing processes in IC engines and engines systems production, and also with specific activities during development and manufacturing. Also, the engines use and maintenance, and repair processes will be considered.

**learning outcomes**

Knowledge of manufacturing processes in production and operation facilities, which deals with IC engines and their systems, and their use, maintenance and repair processes.

**theoretical teaching**

Introduction. The role and importance of engineering practice in engineers education. Basics measures in the field of industrial safety, use of safety and protection equipment, with particular review in the field of IC engines.

**practical teaching**

Consultations, laboratory work and seminar paper are main forms of practical training. During consultations, students are presented with curriculum of Engineering practice. Also, they become acquainted about communication during practical training, how to keep a practice diary and how to prepare seminar paper. Laboratory sessions can be performed in Center of IC engines at Faculty of Mechanical Engineering, in firms which design and manufacture engines, parts and engine systems, as well as in transportation firms and service shops.

**prerequisite**

No requirements for attending this course

**learning resources**

Instructions for Engineering practice to carry out (PDF file).

**number of hours**

**total number of hours:** 46

**active teaching (theoretical)**

lectures: 0

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 26
calculation tasks: 0
seminar works: 5
project design: 0
consultations: 10
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 50
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

**references**
Engineering Practice Bsc - IC Engines

**ID:** BSc-0484  
**teaching professor:** Цветић Р. Милош  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 1  
**final exam:** seminar works  
**parent department:** internal combustion engines

**goals**

Students will be acquainted with technological and manufacturing processes in IC engines and engines systems production, and also with specific activities during development and manufacturing. Also, the engines use and maintenance, and repair processes will be considered.

**learning outcomes**

Knowledge of manufacturing processes in production and operation facilities, which deals with IC engines and their systems, and their use, maintenance and repair processes.

**theoretical teaching**

Introduction. The role and importance of engineering practice in engineers education. Basics measures in the field of industrial safety, use of safety and protection equipment, with particular review in the field of IC engines.

**practical teaching**

Consultations, laboratory work and seminar paper are main forms of practical training. During consultations, students are presented with curriculum of Engineering practice. Also, they become acquainted about communication during practical training, how to keep a practice diary and how to prepare seminar paper. Laboratory sessions can be performed in Center of IC engines at Faculty of Mechanical Engineering, in firms which design and manufacture engines, parts and engine systems, as well as in transportation firms and service shops.

**prerequisite**

No requirements for attending this course

**learning resources**

Instructions for Engineering practice to carry out (PDF file).

**number of hours**

**total number of hours:** 46

**active teaching (theoretical)**

lectures: 10

**active teaching (practical)**

auditory exercises: 0  
laboratory exercises: 10
calculation tasks: 0
seminar works: 5
project design: 0
consultations: 5
discussion and workshop: 6
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 5
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 50
project design: 0
final exam: 40
requirements to take the exam (number of points): 35

references
Exploitation and overhaul of engines

ID: BSc-0634

**teaching professor:** Цветић Р. Милош

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** internal combustion engines

**goals**

Expanding knowledge in the basic problems of engine exploitation, typical failures and overhaul process. Practical application of the gained knowledge on actual physical object. Expanding knowledge in On-Board diagnostics with modern engines. Gaining knowledge of general structure and realization of major overhaul and major overhaul operations. Training for the diagnostics of the cause and type of wear of basic engine parts. Expanding knowledge in the methods of the service of engine in exploitation.

**learning outcomes**


**theoretical teaching**


**practical teaching**

a) Classroom sessions: 1. Presentation of typical failures of engine parts and systems. 2. Preparation for laboratory sessions, assembling and disassembling of engine. 3. Analysis of the importance of engine maintenance process for its durability and exploitation reliability. b) Laboratory sessions: 1. Disassembling and assembling of engine. 2. Presentation of engine operation on test bench for the purpose of testing before exploitation. 3. Excursion-a visit to a service for engine parts processing.

**prerequisite**

Knowledge of engine design is desirable.

**learning resources**

Handouts (PDF files). Instructions to carry out laboratory sessions (PDF files). Numerical examples (PDF Trifunović, R: Engine operation, 1st part, Faculty of Mechanical Engineering, Belgrade, 1983. (in serbian). files). Test beds for IC engines testing, measuring equipment, Center for IC engines.
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 8
laboratory exercises: 12
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 10
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 6
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 25
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 45
requirements to take the exam (number of points): 30

references

Hybride Powertrain Systems

ID: BSc-0658
teaching professor: Томић В. Мирољуб
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: internal combustion engines

goals

Coverage and adoption of basic theoretical knowledge on IC Engines, Electric & Hydraulic Drive and variety of Hybrid Powertrain Systems and Fuel Cells, their perspectives and potential applications. Acquaintance with the terms of Renewable and Non-Renewable Energy resources and perspectives of utilization of Bio-Fuels, Alcohols and Hydrogen. Developing skills to analyze and evaluate different concepts of conventional and hybrid powertrain systems regarding fuel economy. Developing skills to make simple models of Powertrain Systems components in order to simulate and evaluate powertrain system behavior during driving cycles.

learning outcomes

Understanding of basic principles of operation and modes of application of IC Engines, Pure Electric Drives and Hybrid Powertrain Systems. Developing capabilities to model, calculate and analyze Power Losses in Vehicle Powertrain System, to determine required Performance of Powertrain System, to evaluate potentials of Fuel Economy Improvement by application of Hybrid Powertrain/Regenerative Braking System.

theoretical teaching


practical teaching


prerequisite

No prerequisites required.
learning resources

S. Popović: Extracts from lectures (handouts).
Numerical examples provided in digital form (coded and prepared for Matlab package).
Mathworks Matlab/Simulink Technical computing software package.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 5
calculation tasks: 6
seminar works: 3
project design: 0
consultations: 4
discussion and workshop: 2
research: 0

knowledge checks

check and assessment of calculation tasks: 4
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 6
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 40
requirements to take the exam (number of points): 30

references

Industrial Compressors

ID: BSc-0567
teaching professor: Цветић Р. Милош
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: internal combustion engines

goals

Acquiring basic knowledge on widely used compressors. Increased practical knowledge of thermodynamics through the study of compression of real gases, gas mixtures and moist gases, and the study of actual working cycles of (at most) reciprocating compressors. Expansion and acquisition of new knowledge in the field of Engineering, through the study of basic structural elements, systems and auxiliary equipment of reciprocating and other types of compressors. Developing skills for the design of reciprocating compressors, selection, testing, installation and maintenance in service.

learning outcomes

Understanding of complex real working cycle of reciprocating compressors working with real gases; Understanding of complex structural design of such machines. Development of critical thinking which leads to sound understanding of cause-effect relationship between working cycle and machine design; Ability to design and accomplish selection, testing, installation and maintenance of reciprocating compressors in service.

theoretical teaching

Reciprocating mechanism kinematics and dynamics; Unevenness of Reciprocating Compressor crankshaft speed; Compressor and crankshaft balance; Theoretical thermodynamic fundamentals of compression processes of ideal and real gases, gas mixtures and moist gases; Theoretical work cycle of piston compressor without dead volume; Actual working cycle of single-stage piston compressor, working media and compressor parameters; Multi-stage compression; Determining compressor size and working space dimensions; Compressor systems and auxiliary equipment; Flow and pressure control of Piston Compressors; Design analysis of various Reciprocating Compressors types; Fundamentals of Compressor Maintenance;

practical teaching

Calculus examples covering theoretical backgrounds of Reciprocating Compressor working process; Evaluation and analysis of various Reciprocating Compressors, its main parts, systems and auxiliary equipment; Insight in Rotational Piston Compressors; Introduction to the Reciprocating compressor testing and instructions for laboratory exercises (Experimentally determining compressor isentropic and volumetric efficiency; Determining of flow coefficients of compressor plate valve )

prerequisite

Basic knowledge of Thermodynamics

learning resources

- M. Cvetić, N. Miljic : Handouts from Lectures and Exercises (PDF files)
- Laboratory for Piston Compressor testing equipped with DAQ measurement equipment and software
- Compressor Valve flow test bench

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 6
laboratory exercises: 4
calculation tasks: 20
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 6
check and assessment of lab reports: 2
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 2
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 10
laboratory exercises: 15
calculation tasks: 25
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 35

**references**

Industrial Compressors

ID: BSc-0699

teaching professor: Томић В. Мирољуб

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: internal combustion engines

goals

Acquiring basic knowledge on industrial compressors. Increased knowledge of thermodynamics through the study of compression of real gases, gas mixtures and moist gases, and the study of actual working cycles of reciprocating compressors. Expansion and acquisition of new knowledge in the field of Engineering, through the study of basic structural elements, systems and auxiliary equipment of reciprocating compressors. Developing skills for the design of reciprocating compressors, selection, testing, installation and maintenance in service.

learning outcomes

Understanding of complex real working cycle of reciprocating compressors working with real gases; Understanding of complex structural design of such machines. Development of critical thinking which leads to sound understanding of cause-effect relationship between working cycle and machine design; Ability to design and accomplish selection, testing, installation and maintenance of reciprocating compressors in service.

theoretical teaching

Reciprocating mechanism kinematics and dynamics; Unevenness of Reciprocating Compressor crankshaft speed; Compressor and crankshaft balance; Theoretical thermodynamic fundamentals of compression processes of ideal and real gases, gas mixtures and moist gases; Theoretical work cycle of piston compressor without dead volume; Actual working cycle of single-stage piston compressor, working media and compressor parameters; Multi-stage compression; Determining compressor size and working space dimensions; Compressor systems and auxiliary equipment; Flow and pressure control of Piston Compressors; Design analysis of various Reciprocating Compressors types; Fundamentals of Compressor Maintenance;

practical teaching

Calculus examples covering theoretical backgrounds of Reciprocating Compressor working process; Evaluation and analysis of various Reciprocating Compressors, its main parts, systems and auxiliary equipment; Insight in Rotational Piston Compressors; Introduction to the Reciprocating compressor testing and instructions for laboratory exercises (Experimentally determining compressor isentropic and volumetric efficiency; Determining of flow coefficients of compressor plate valve)

prerequisite

Basic knowledge of Thermodynamics

learning resources

- M. Cvetić, N. Miljic : Handouts from Lectures and Exercises
Laboratory for Piston Compressor testing equipped with DAQ measurement equipment and software
- Compressor Valve flow test bench

**number of hours**

Total number of hours: 75

**active teaching (theoretical)**

Lectures: 30

**active teaching (practical)**

Auditory exercises: 6
Laboratory exercises: 4
Calculation tasks: 20
Seminar works: 0
Project design: 0
Consultations: 0
Discussion and workshop: 0
Research: 0

**knowledge checks**

Check and assessment of calculation tasks: 6
Check and assessment of lab reports: 2
Check and assessment of seminar works: 0
Check and assessment of projects: 0
Colloquium, with assessment: 0
Test, with assessment: 2
Final exam: 5

**assessment of knowledge (maximum number of points - 100)**

Feedback during course study: 10
Test/colloquium: 10
Laboratory exercises: 15
Calculation tasks: 25
Seminar works: 0
Project design: 0
Final exam: 40
Requirements to take the exam (number of points): 30

**references**

Internal combustion engines

ID: BSc-0613
teaching professor: Томић В. Мирољуб
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: internal combustion engines

goals

The aims of the course are to provide a comprehensive insight into the subject matter of Internal Combustion Engines (theoretical operating cycle, real operating cycle, engine systems, engine operating characteristics). It is intended for students of the Internal Combustion Engines module as an in-depth introduction into studies of specific areas of Internal Combustion Engines, as well as for students of modules which require knowledge of Internal Combustion Engines as a power unit (Motor vehicles, Naval Architecture, Railway Mechanical Engineering, and Material Handling, Constructions and Logistics).

learning outcomes

Acquired theoretical and practical knowledge of Internal Combustion Engines. The ability to link fundamental engineering branches of thermodynamics, fluid mechanics, mechanics, strength of materials etc. into a complex unit such as engine. The ability of competent approach to engine selection, organization of exploitation and maintenance. Acquisition of solid base for tackling specific problems, design and construction of Internal Combustion Engines.

theoretical teaching


practical teaching


Laboratory exercises: Fuel supply systems for Otto and Diesel engines and engine electrical systems. Testing of engine characteristics on the test bench.

prerequisite

No prerequisites required.
learning resources

2. M. Tomić & S. Popović: Lecture notes (handouts) - Basics of Internal Combustion Engines, available in e-form in pdf on the site of the Chair of Internal Combustion Engines
3. IC Engine testing Laboratory (with an engine on the test bed)
5. National Instruments LabView

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 9
laboratory exercises: 8
calculation tasks: 10
seminar works: 0
project design: 0
consultations: 3
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 5
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 20
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references
Operation and overhaul of engines

ID: BSc-0700
teaching professor: Томић В. Мирољуб
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: internal combustion engines

goals

Expanding knowledge in the basic problems of engine exploitation, typical failures and overhaul process. Practical application of the gained knowledge on actual physical object. Expanding knowledge in On-Board diagnostics with modern engines. Gaining knowledge of general structure and realization of major overhaul and major overhaul operations. Training for the diagnostics of the cause and type of wear of basic engine parts. Expanding knowledge in the methods of the service of engine in exploitation.

learning outcomes


theoretical teaching


practical teaching

a) Classroom sessions: 1. Presentation of typical failures of engine parts and systems. 2. Preparation for laboratory sessions, assembling and disassembling of engine. 3. Analysis of the importance of engine preventive maintenance process for its durability and exploitation reliability. b) Laboratory sessions: 1. Disassembling and assembling of engine. 2. Presentation of engine operation on test bench for the purpose of testing before exploitation. 3. Excursion-a visit to a service for engine parts processing.

prerequisite

Knowledge of engine design is desirable.

learning resources
Handouts (PDF files). Instructions to carry out laboratory sessions (PDF files). Numerical examples (PDF Trifunović, R: Engine operation, 1st part, Faculty of Mechanical Engineering, Belgrade, 1983. (in serbian). files). Test beds for IC engines testing, measuring equipment, Center for IC engines.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 9
laboratory exercises: 16
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references

Reciprocating Compressors

ID: BSc-0152

**teaching professor:** Цветић Р. Милош

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** internal combustion engines

**goals**

Acquiring basic knowledge on reciprocating compressors. Increased knowledge of thermodynamics through the study of compression of real gases, gas mixtures and moist gases, and the study of actual working cycles of reciprocating compressors. Expansion and acquisition of new knowledge in the field of Engineering, through the study of basic structural elements, systems and auxiliary equipment of reciprocating compressors. Developing skills for the design of reciprocating compressors, selection, testing, installation and maintenance in service.

**learning outcomes**

Understanding of complex real working cycle of reciprocating compressors working with real gases; Understanding of complex structural design of such machines. Development of critical thinking which leads to sound understanding of cause-effect relationship between working cycle and machine design; Ability to design and accomplish selection, testing, installation and maintenance of reciprocating compressors in service.

**theoretical teaching**

Reciprocating mechanism kinematics and dynamics; Unevenness of Reciprocating Compressor crankshaft speed; Compressor and crankshaft balance; Theoretical thermodynamic fundamentals of compression processes of ideal and real gases, gas mixtures and moist gases; Theoretical work cycle of piston compressor without dead volume; Actual working cycle of single-stage piston compressor, working media and compressor parameters; Multi-stage compression; Determining compressor size and working space dimensions; Compressor systems and auxiliary equipment; Flow and pressure control of Piston Compressors; Design analysis of various Reciprocating Compressors types; Fundamentals of Compressor Maintenance;

**practical teaching**

Calculus examples covering theoretical backgrounds of Reciprocating Compressor working process; Evaluation and analysis of various Reciprocating Compressors, its main parts, systems and auxiliary equipment; Insight in Rotational Piston Compressors; Introduction to the Reciprocating compressor testing and instructions for laboratory exercises (Experimentally determining compressor isentropic and volumetric efficiency; Determining of flow coefficients of compressor plate valve )

**prerequisite**

Basic knowledge of Thermodynamics

**learning resources**

- M. Cvetić, N. Miljic : Handouts from Lectures and Exercises (PDF files)
- Laboratory for Piston Compressor testing equipped with DAQ measurement equipment and software
- Compressor Valve flow test bench

**number of hours**

Total number of hours: 75

**active teaching (theoretical)**

Lectures: 30

**active teaching (practical)**

Auditory exercises: 6
Laboratory exercises: 4
Calculation tasks: 20
Seminar works: 0
Project design: 0
Consultations: 0
Discussion and workshop: 0
Research: 0

**knowledge checks**

Check and assessment of calculation tasks: 6
Check and assessment of lab reports: 2
Check and assessment of seminar works: 0
Check and assessment of projects: 0
Colloquium, with assessment: 0
Test, with assessment: 2
Final exam: 5

**assessment of knowledge (maximum number of points - 100)**

Feedback during course study: 10
Test/colloquium: 10
Laboratory exercises: 15
Calculation tasks: 25
Seminar works: 0
Project design: 0
Final exam: 40
Requirements to take the exam (number of points): 35

**references**

material handling, construction and logistics

Elements of Construction and Mining Machines
Fundamentals of steel structures
Material Handling Equipment
Professional Practice - TCL
Elements of Construction and Mining Machines

**ID:** BSc-0044  
**teaching professor:** Бошњак М. Срђан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** oral  
**parent department:** material handling, constructios and logistics

**goals**

Basic course goals (objectives): 1) introducing students with specificities of working process, design, modeling and calculation of construction and mining machines and appliances. 2) mastering practical skills which are necessary for selection, design and calculation of construction and mining machines.

**learning outcomes**

Mastering the curriculum student gains (acquires): 1) general skills which can be used in engineering practice (analysis, synthesis and anticipation of solution and consequences; development of critical approach) 2) specific skills (use of knowledge gain in fundamental academic fields on solving of concrete problems in field of construction and mining machines).

**theoretical teaching**


**practical teaching**


**prerequisite**


**learning resources**

1. Srđan Bošnjak, Bucket Wheel Trenchers, University of Belgrade, Faculty of Mechanical Engineering, Belgrade, 2001., 2. Srđan Bošnjak, Handouts, University of Belgrade, Faculty of Mechanical Engineering, Belgrade, 2008., 3. Srdan Bošnjak, Elements of construction and mining machines, - Instructions for project realization, University of Belgrade, Faculty of Mechanical Engineering, Belgrade, 2008., Computers, Laboratory 516, 5. Software Mathlab, (Catia)
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 9
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 15
consultations: 5
discussion and workshop: 1
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 4
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 35
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 25
final exam: 30
requirements to take the exam (number of points): 35

references

**Fundamentals of steel structures**

**ID:** BSc-0095  
**teaching professor:** Петковић Д. Зоран  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** material handling, constructios and logistics

**goals**

Basic goals of this course are: 1) introduction to logical principles in design and calculation of steel structures in mechanical engineering, 2) development of student creative skills in design of characteristic structural systems throughout phases of idealization, parameterization and calculation

**learning outcomes**

Students will obtain appreciation of structural behavior as essential part of the structural designer’s background. They are qualified to comprehend basics of analysis of structural systems. Also, students are introduced to phases of design and involved in projects in structural systems in mechanical engineering.

**theoretical teaching**


**practical teaching**

Stresses and deflections for simple beam and cantilever due to various loads. Calculation of bolted connections (with machine bolts and high-strength bolts). Beam (I cross section) design methods and calculations. Calculation of fillet weld and bevel weld connections. Connections at brackets. Calculation of flexural buckling of columns and lateral buckling of beams. Influence lines. Calculation of forces in the members of statically determinate trusses.

**prerequisite**

Necessary courses: Mathematics 1, Strenght of materials, Machine materials.  
Advisable course: Machine elements.

**learning resources**

1. Zoran Petkovic, Davor Ostric: Metalne konstrukcije u masinogradji 1, Faculty of Mechanical Engineering, Belgrade 1996.  
2. Handouts

**number of hours**

**total number of hours:** 75

**active teaching (theoretical)**
lectures: 30

active teaching (practical)

auditory exercises: 20
laboratory exercises: 0
calculation tasks: 6
seminar works: 0
project design: 0
consultations: 4
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 4
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 20
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references
Material Handling Equipment

ID: BSc-0264
teaching professor: Зрнић Ђ. Ненад
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: material handling, constructions and logistics

goals

The basic goal of this subject is to introduce students into the fundamentals of intralogistics (material handling equipment in intralogistics) and to enable achieving practical skills in engineering education and professional work such as are analysis of duty cycle of material handling equipment, selection, sizing and calculation of material handling equipment as elements of material handling and conveying machines.

learning outcomes

Mastering the curriculum students obtain general abilities that can be applied in engineering practice: knowledge and principles of material handling equipment, selection of parameters, the size and computer modeling of material handling equipment and the ability for calculating and solving concrete problems in practice.

theoretical teaching

Introduction into intralogistics and material handling equipment, significance of this field, historical development, classification, types and shapes of materials which have to be handled, application groups, classification into application groups. Elements of driving mechanisms (selection, sizing, calculation), ropes and chains, load handling attachments (hooks, triangular hooks, pulley blocks, slings), sheaves, drums, brakes and arresting gears. Mechanisms for lifting, hand operated hoisting devices (screw-type jack, rack-and-lever jack, hydraulic jack, lever hoist, chain hoist, rope hoist), crane crabs for unit, piece and bulk loads (crane clamps and grabs, carrier beams, electric lifting magnets, vacuum lifters, grab buckets, spreaders), hoists with electric motor, calculation of mechanisms. Mechanisms for translational movement of trolleys and cranes, resistance to motion, wheels, rails, slipping, braking, calculation of mechanism.

practical teaching

Video presentations of machines and principles of material handling equipment operation as well as hoists and cranes. Determination of application groups for hoists and cranes, based on the load spectrum. Calculation of the elements of the drives, calculation of force in rope and chain in slings and pulley blocks. Calculation of drums and shoe brakes. Calculation of lifting mechanism, selection and adoption of application group. Calculation of mechanisms for translational motion, the selection and adoption of application group, calculation and defining the diameter of wheel and rail, checking security against slipping. Laboratory exercises on the computer, 3D modeling of material handling equipment in CATIA software.

prerequisite

learning resources

1. Nenad Zrnic: Material handling equipment - Handouts and written lectures, 2011, DVL.
2. Slobodan Tosic, D. Ostric: Cranes, Faculty of Mechanical Engineering, 2005, KDA.
3. Computers, Laboratory 516, ICT / CAH
4. Software package CATIA, ICT / CSP

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 15
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 9
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 45
laboratory exercises: 15
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references
Professional Practice - TCL

**ID:** BSc-0365

**teaching professor:** Петковић Д. Зоран

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 1

**final exam:** seminar works

**parent department:** material handling, constructios and logistics

**goals**

The goal of course is to acquaint students with the resources, machines and devices in the field of machinery used in various industries, especially in industry, construction, mining, transport, tourism, energy, process engineering, service industries.

**learning outcomes**

With the successful completion of course students are introduced to: 1 Production processes in companies that produce or use machines and devices for mechanization, 2 Intermittent and continuous internal transport.

**theoretical teaching**

Introduction. The basic principles of machines and devices for machinery. Fundamentals of technological processes in industry to manufacture machinery and construction machinery in the area. Fundamentals of design of transport and logistics systems.

**practical teaching**

Organization of visits to factories and metal processing complexes where machines and devices in the field of machinery and construction are produced, as well as visits to industrial companies that use internal transport means which are also an integral part of production and technological processes, and organization of visits to factories that produce steel structures, and elements of steel and concrete structures, where students acquire the necessary knowledge in the fields of planning and organization of production processes, use of internal resources and transportation machinery, machine maintenance and internal transport machinery, transport vehicles to increase the capacity and the capacity of transport vehicles the impact on the efficiency of production processes, maintenance of transport vehicles and machinery for mechanization.

**prerequisite**

Enrolled 4th semester.

**learning resources**


**number of hours**

**total number of hours:** 46

**active teaching (theoretical)**
lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

cHECK and assessment of calculation tasks: 0
check and assessment of lab reports: 0
cHECK and assessment of seminar works: 0
cHECK and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 0

references

Z. PETKOVIC, Metal construction in Mechanical engineering, Belgrade, 1996.
Zrnic Dj., Prokic M., P. Milovic, Design foundry, Belgrade
mathematics

Computer modeling and animation
COMPUTING TOOLS
Essential programming in C
Introduction to Probability and Statistics
Mathematics 1
Mathematics 1
Mathematics 2
Mathematics 2
Mathematics 3
Mathematics 3
Numerical methods
Numerical methods.
Object oriented programming with java
PROGRAMMING
Computer modeling and animation

**ID:** BSc-0591
**teaching professor:** Цветковић С. Александар
**level of studies:** B.Sc. (undergraduate) academic studies
**ECTS credits:** 6
**final exam:** written
**parent department:** mathematics

**goals**

The aim of this course is to provide an overview of the theoretical basis of computer modeling using 3D Studio MAX, to present some of the practical aspects of computer modeling, as well as to provide the necessary knowledge to create animations in mechanical engineering.

**learning outcomes**

The audience of this course will acquire basic theoretical knowledge of computer modeling and animation. In addition, students will be provided practical knowledge of computer modeling using 3D Studio MAX. Students will make presentations of various 3D models. The knowledge acquired can be applied to any type of computer modeling in mechanical engineering, and may also be used in making and animation in mechanical engineering.

**theoretical teaching**


**practical teaching**


**prerequisite**

Advanced computer skills.

**learning resources**

Springer - Verlag, 2008.
Software: 3D Studio Max

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 15
laboratory exercises: 10
calculation tasks: 0
seminar works: 5
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 2
check and assessment of seminar works: 2
check and assessment of projects: 0
colloquium, with assessment: 3
test, with assessment: 3
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 20
calculation tasks: 0
seminar works: 10
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references

Kelly L. Murdock, 3ds Max Bible, Wiley Publishing, 20011.
COMPUTING TOOLS

ID: BSc-0016

**teaching professor:** Аранђеловић Д. Иван

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 4

**final exam:** written+oral

**parent department:** mathematics

**goals**

The student should learn the process of solving mathematical problems in the MATLAB program package. In addition, the student is familiarized with limitations of computational technique and error management in numerical procedures.

**learning outcomes**

1. The student should be familiar with characteristics and specifics of the MATLAB program package.

2. He should master theoretical fundamentals of high-level computational tools.

3. He should master programming methods in the MATLAB package.

4. He should be familiar with limitations of computational technique.

**theoretical teaching**


**practical teaching**


**prerequisite**

No prerequisites.

**learning resources**


**number of hours**

total number of hours: 45
active teaching (theoretical)

lectures: 18

active teaching (practical)

auditory exercises: 0
laboratory exercises: 18
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 7
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 2

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 50
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 21

references

Amos Gilat, Introduction to MATLAB 7 with applications, Mikro knjiga Beograd 2005.
Essential programming in C

ID: BSc-0670

teaching professor: Радојевић Љ. Слободан

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 4

final exam: written

parent department: mathematics

goals

The main objective of this course is to introduce students to the use C as programming language. It will be especially prominent characteristic to use C in Mechanical Engineering, characterized by analysis of the data collected in real time. Students must be:

• familiar with the data types and data structures;
• identify common use of the programming language C;
• use basic commands and C, and with their help solve simple engineering problems;
• familiar with using C for the analysis of data characteristic of Mechanical Engineering;
• familiar with basic programming techniques, which are characterized not only C.

learning outcomes

After successful completion of the course, students can:

• to recognize the possible use of C programming language to solve some problems in Mechanical Engineers.
• to gain basic knowledge of the principles of programming in C;
• to use the file.

theoretical teaching

Types and sizes of data. Constants.
Operators. Priority and order of calculation.
Statements and blocks.
Branch instruction program.
Loop.
Unconditional jump commands.
Basic concepts of functions. External variables. Policies range.
Using files.

practical teaching

Workshops with basic examples in C.

prerequisite

A high school mathematics and programming.

learning resources

The necessary software for this course is under the GNU license - free of charge.
If you use Linux then you C/C++ is available immediately.
If you are using another operating system, C/C++ can be downloaded from the corresponding web site (see URL) or the URL.
To run the software necessary to possess enough simplest PC.
number of hours

total number of hours: 45

active teaching (theoretical)

lectures: 15

active teaching (practical)

auditory exercises: 5
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 5
research: 0

knowledge checks

check and assessment of calculation tasks: 5
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 2
test, with assessment: 0
final exam: 3

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 10
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 50
requirements to take the exam (number of points): 50

references

Introduction to Probability and Statistics

**ID:** BSc-0543  
**teaching professor:** Аранђеловић Д. Иван  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** mathematics

**goals**

Introduction to techniques of probability theory, reliability theory, mathematical statistics and their most important application in technics. Introduction to techniques of regression analysis and stochastic modelling.

**learning outcomes**

Training students for usage of probability theory, reliability theory and mathematical statistics in solving technical problems, as well as development of the capabilities for its own modeling of nondeterministic systems.

**theoretical teaching**


**practical teaching**


**prerequisite**

No prerequisites.

**learning resources**


**number of hours**

276
total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 5
calculation tasks: 10
seminar works: 0
project design: 0
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 5
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 30
laboratory exercises: 5
calculation tasks: 20
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 21

references

Mathematics 1

ID: BSc-0505

teaching professor: Раденовић Н. Стојан

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: mathematics

goals

The aim of the course Mathematics 1 is to introduce students to basics of the following topics:
Vector algebra, matrices and determinants, system of linear equations, planes and lines in analytic geometry, differential calculus of real functions in one real variable, curves as hodographs of vector functions.

learning outcomes

The main outcome from studying Mathematics 1 is improving the general education level, forming work habits and systematic in work, as well as developing professional strictness. Having mastered the curriculum of the course Mathematics 1, the student should understand the topics to the point of being able to solve specific problems and of successfully attending technical courses during continued studies.

theoretical teaching

Vector algebra, matrices and determinants, system of linear equations, equations of planes and lines, planar quadratic curves, quadratic surfaces, notion of a function, basic elementary real functions in one real variable, limit and continuity of a real function, differentiation of real functions in one real variable, applications of differentiation in analyzing functions, basic theorems on differentiable functions (Rolle's, Lagrange's and Cauchy's theorems, L'Hospital rule, Taylor's theorem), curves as hodographs of vector functions, natural trihedon, curvature and torsion of a curve, osculating circle, evolute and involute of a plane curve.

practical teaching

Vector algebra, matrices and determinants, system of linear equations, equations of planes and lines, planar quadratic curves, quadratic surfaces, notion of a function, basic elementary real functions in one real variable, limit and continuity of a real function, differentiation of real functions in one real variable, applications of differentiation in analyzing functions, basic theorems on differentiable functions (Rolle's, Lagrange's and Cauchy's theorems, L'Hospital rule, Taylor's theorem), curves as hodographs of vector functions, natural trihedon, curvature and torsion of a curve, osculating circle, evolute and involute of a plane curve.

prerequisite

The course attendance is determined by the curriculum of study program.

learning resources

Written handouts from lectures in Mathematics 1: Lesson 1, Lesson 2, Lesson 3, Lesson 4, Lesson 5, Lesson 6, Lesson 7, Lesson 8, Lesson 9.

All the necessary literature is on:
http://147.91.27.133 or ftp://147.91.27.133
**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 45

**active teaching (practical)**

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 0

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 70
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

**references**

Mathematics 1

ID: BSc-0669
teaching professor: Додер Ј. Драган
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written
parent department: mathematics

goals

The aim of the course Mathematics 1 is to introduce students to basics of the following topics: Vector algebra, matrices and determinants, system of linear equations, planes and lines in analytic geometry, differential calculus of real functions in one real variable, curves as hodographs of vector functions.

learning outcomes

The main outcome from studying Mathematics 1 is improving the general education level, forming work habits and systematic in work, as well as developing professional strictness. Having mastered the curriculum of the course Mathematics 1, the student should understand the topics to the point of being able to solve specific problems and of successfully attending technical courses during continued studies.

theoretical teaching

Vector algebra, matrices and determinants, system of linear equations, equations of planes and lines, planar quadratic curves, quadratic surfaces, notion of a function, basic elementary real functions in one real variable, limit and continuity of a real function, differentiation of real functions in one real variable, applications of differentiation in analyzing functions, basic theorems on differentiable functions (Rolle's, Lagrange's and Cauchy's theorems, L'Hospital rule, Taylor's theorem), curves as hodographs of vector functions, natural trihedron, curvature and torsion of a curve, osculating circle, evolute and involute of a plane curve.

practical teaching

Vector algebra, matrices and determinants, system of linear equations, equations of planes and lines, planar quadratic curves, quadratic surfaces, notion of a function, basic elementary real functions in one real variable, limit and continuity of a real function, differentiation of real functions in one real variable, applications of differentiation in analyzing functions, basic theorems on differentiable functions (Rolle's, Lagrange's and Cauchy's theorems, L'Hospital rule, Taylor's theorem), curves as hodographs of vector functions, natural trihedron, curvature and torsion of a curve, osculating circle, evolute and involute of a plane curve.

prerequisite

The course attendance is determined by the curriculum of study program.

learning resources

Written handouts from lectures in Mathematics 1: Lesson 1, Lesson 2, Lesson 3, Lesson 4, Lesson 5, Lesson 6, Lesson 7, Lesson 8, Lesson 9.

All the necessary literature is on: http://147.91.27.133 or ftp://147.91.27.133
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 32

active teaching (practical)

auditory exercises: 31
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 4

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 70
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

Mathematics 2

ID: BSc-0671
teaching professor: Аранђеловић Д. Иван
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: mathematics

goals

The aim of the course Mathematics 2 is to introduce students to basics of the following topics: Indefinite and definite integrals and their applications, differential calculus of real-valued multi-variable functions (which depend on several independent real variables), first-order differential equations.

learning outcomes

The main outcome from studying Mathematics 2 is improving the general education level, forming work habits and systematic in work, as well as developing professional strictness. Having mastered the curriculum of the course Mathematics 2, the student should understand the topics to the point of being able to solve specific problems and of successfully attending technical courses during continued studies.

theoretical teaching

Indefinite integral, definition, methods of integration, integration of rational functions and some irrational and transcendental functions, definite integral, definition, existence, basic properties, basic theorem of integral calculus, methods of integration of definite integral, improper integrals, quadrature of plane figure, cubature of solid of revolution, rectification of curve, surface of solid of revolution, differential calculus of real-valued multi-variable functions (which depend on several independent real variables), Taylor’s theorem, local extreme values of a function with two independent variables, surface as hodograph of a vector-function depends on two independent variables, tangent plane and normal to surface, first-order differential equations, the method of separation of variables, first-order homogenous differential equations, first-order linear and Bernoulli differential equations, exact differential equations, integration factor, orthogonal and isogonal trajectories.

practical teaching

Indefinite integral, definition, methods of integration, integration of rational functions and some irrational and transcendental functions, definite integral, definition, existence, basic properties, basic theorem of integral calculus, methods of integration of definite integral, improper integrals, quadrature of plane figure, cubature of solid of revolution, rectification of curve, surface of solid of revolution, differential calculus of real-valued multi-variable functions (which depend on several independent real variables), Taylor’s theorem, local extreme values of a function with two independent variables, surface as hodograph of a vector-function depends on two independent variables, tangent plane and normal to surface, first-order
differential equations, the method of separation of variables, first-order homogenous
differential equations, first-order linear and Bernoulli differential
equations, exact differential equations, integration factor, orthogonal and isogonal trajectories.

**prerequisite**

The course attendance condition is determined by the curriculum of study program.

**learning resources**

Written handouts from lectures in Mathematics 3: Lesson 1, Lesson 2, Lesson 3, Lesson 4,
Lesson 5, Lesson 6, Lesson 7, Lesson 8, Lesson 9.

All the necessary literature is on:
http://147.91.27.133 or ftp://147.91.27.133

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 4
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35
references

D. Tošić, M. Albijanić, D. Milenković, Elements of differentialal and integral calculus, Službeni glasnik, Beograd 2012
Mathematics 2

ID: BSc-0370
teaching professor: Спалевић М. Миодраг
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written
parent department: mathematics

goals

The aim of the course Mathematics 2 is to introduce students to basics of the following topics: Indefinite and definite integrals and their applications, differential calculus of real-valued multi-variable functions (wich depend on several independent real variables), first-order differential equations.

learning outcomes

The main outcome from studying Mathematics 2 is improving the general education level, forming work habits and systematic in work, as well as developing professional strictness. Having mastered the curriculum of the course Mathematics 2, the student should understand the topics to the point of being able to solve specific problems and of successfully attending technical courses during continued studies.

theoretical teaching

Indefinite integral, definition, methods of integration, integration of rational functions and some irrational and transcendental functions, definite integral, definition, existence, basic properties, basic theorem of integral calculus, methods of integration of definite integral, improper integrals, quadrature of plane figure, cubature of solid of revolution, rectification of curve, surface of solid of revolution, differential calculus of real-valued multi-variable functions (which depend on several independent real variables), Taylor's theorem, local extreme values of a function with two independent variables, surface as hodograph of a vector-function depends on two independent variables, tangent plane and normal to surface, first-order differential equations, the method of separation of variables, first-order homogenous differential equations, first-order linear and Bernoulli differential equations, exact differential equations, integration factor, orthogonal and isogonal trajectories.

practical teaching

Indefinite integral, definition, methods of integration, integration of rational functions and some irrational and transcendental functions, definite integral, definition, existence, basic properties, basic theorem of integral calculus, methods of integration of definite integral, improper integrals, quadrature of plane figure, cubature of solid of revolution, rectification of curve, surface of solid of revolution, differential calculus of real-valued multi-variable functions (which depend on several independent real variables), Taylor's
theorem, local extreme values of a function with two independent variables, surface as hodograph of a vector-function depends on two independent variables, tangent plane and normal to surface, first-order differential equations, the method of separation of variables, first-order homogenous differential equations, first-order linear and Bernoulli differential equations, exact differential equations, integration factor, orthogonal and isogonal trajectories.

prerequisite

The course attendance condition is determined by the curriculum of study program.

learning resources

Written handouts from lectures in Mathematics 3: Lesson 1, Lesson 2, Lesson 3, Lesson 4, Lesson 5, Lesson 6, Lesson 7, Lesson 8, Lesson 9.

All the necessary literature is on: http://147.91.27.133 or ftp://147.91.27.133

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 70
laboratory exercises: 0
calculation tasks: 0
seminar works: 0  
project design: 0  
final exam: 30  
requirements to take the exam (number of points): 35  

references  
Mathematics 3

ID: BSc-0672
teaching professor: Спалевић М. Миодраг
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written
parent department: mathematics

goals

The aim of the course Mathematics 3 is to introduce students to basics of the following topics: Linear differential equations of higher order, linear systems of differential equations, path and line integrals, multiple integrals, scalar and vector fields.

learning outcomes

The main outcome from studying Mathematics 3 is improving the general education level, forming work habits and systematic in work, as well as developing professional strictness. Having mastered the curriculum of the course Mathematics 3, the student should understand the topics to the point of being able to solve specific problems and of successfully attending technical courses during continued studies.

theoretical teaching

Linear differential equations of higher order, linear systems of differential equations, path and line integrals with applications, double integrals (definition, properties, evaluation, change of variables in double integrals), application of double integrals in computing solid volumes and surface areas, Green's theorem, triple integrals (definition, properties, evaluation, change of variables), improper double and triple integrals, surface integrals (definition, properties, evaluation, Stokes' and Gauss-Ostrogradsky theorems, path independence of line integrals, scalar and vector fields, gradient of a scalar field, vector lines, divergence and curl of a vector field, work and flow of a vector field, classification of vector fields.

practical teaching

Linear differential equations of higher order, linear systems of differential equations, path and line integrals with applications, double integrals (definition, properties, evaluation, change of variables in double integrals), application of double integrals in computing solid volumes and surface areas, Green's theorem, triple integrals (definition, properties, evaluation, change of variables), improper double and triple integrals, surface integrals (definition, properties, evaluation, Stokes' and Gauss-Ostrogradsky theorems, path independence of line integrals, scalar and vector fields, gradient of a scalar field, vector lines, divergence and curl of a vector field, work and flow of a vector field, classification of vector fields.

prerequisite

The course attendance conditions is determined by the curriculum of study program.

learning resources

Written handouts from lectures in Mathematics 3: Lesson 1, Lesson 2, Lesson 3, Lesson 4, Lesson 5, Lesson 6, Lesson 7, Lesson 8, Lesson 9.

All the necessary literature is on:
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 45

active teaching (practical)

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 70
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

Mathematics 3

**ID:** BSc-0017  
**teaching professor:** Раденовић Н. Стојан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** mathematics

**goals**

The aim of the course Mathematics 3 is to introduce students to basics of the following topics: Linear differential equations of higher order, linear systems of differential equations, path and line integrals, multiple integrals, scalar and vector fields.

**learning outcomes**

The main outcome from studying Mathematics 3 is improving the general education level, forming work habits and systematic in work, as well as developing professional strictness. Having mastered the curriculum of the course Mathematics 3, the student should understand the topics to the point of being able to solve specific problems and of successfully attending technical courses during continued studies.

**theoretical teaching**

Linear differential equations of higher order, linear systems of differential equations, path and line integrals with applications, double integrals (definition, properties, evaluation, change of variables in double integrals), application of double integrals in computing solid volumes and surface areas, Green's theorem, triple integrals (definition, properties, evaluation, change of variables), improper double and triple integrals, surface integrals (definition, properties, evaluation, Stokes' and Gauss-Ostrogradsky theorems, path independence of line integrals, scalar and vector fields, gradient of a scalar field, vector lines, divergence and curl of a vector field, work and flow of a vector field, classification of vector fields.

**practical teaching**

Linear differential equations of higher order, linear systems of differential equations, path and line integrals with applications, double integrals (definition, properties, evaluation, change of variables in double integrals), application of double integrals in computing solid volumes and surface areas, Green's theorem, triple integrals (definition, properties, evaluation, change of variables), improper double and triple integrals, surface integrals (definition, properties, evaluation, Stokes' and Gauss-Ostrogradsky theorems, path independence of line integrals, scalar and vector fields, gradient of a scalar field, vector lines, divergence and curl of a vector field, work and flow of a vector field, classification of vector fields.

**prerequisite**

The course attendance conditions is determined by the curriculum of study program.

**learning resources**

Written handouts from lectures in Mathematics 3: Lesson 1, Lesson 2, Lesson 3, Lesson 4, Lesson 5, Lesson 6, Lesson 7, Lesson 8, Lesson 9.

All the necessary literature is on:
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 45

active teaching (practical)

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 0

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 70
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

Numerical methods

ID: BSc-0673
teaching professor: Цветковић С. Александар
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: mathematics

goals

The main goal of this subject is to introduce the students with the basics of the numerical and functional series theory and the theory of numerical computation, as well as to demonstrate some implementation of the numerical methods in Matlab.

learning outcomes

Students gain knowledge about numerical and functional series, and their application in approximation. Subject of the study is number representation in computers, problems occurring during computation with approximate quantities, numerical methods for the solutions of linear and non linear equations, methods of interpolation, methods for numerical differentiation and integration as well as numerical methods for the solution of ordinary differential equations. Knowledge is supported by practical introduction through Matlab.

theoretical teaching


practical teaching


**prerequisite**

No prerequisites.

**learning resources**

Software: Matlab.

**number of hours**

Total number of hours: 75

**active teaching (theoretical)**

Lectures: 30

**active teaching (practical)**

Auditory exercises: 15
Laboratory exercises: 15
Calculation tasks: 0
Seminar works: 0
Project design: 0
Consultations: 0
Discussion and workshop: 0
Research: 0

**knowledge checks**

Check and assessment of calculation tasks: 0
Check and assessment of lab reports: 5
Check and assessment of seminar works: 0
Check and assessment of projects: 0
Colloquium, with assessment: 5
Test, with assessment: 0
Final exam: 5

**assessment of knowledge (maximum number of points - 100)**

Feedback during course study: 10
Test/colloquium: 30
Laboratory exercises: 30
Calculation tasks: 0
Seminar works: 0
Project design: 0
Final exam: 30
requirements to take the exam (number of points): 21

references

Г.В. Миловановић, М. Ковачевић, М. Спалевић, Нумеричка Математика - Збирка решених проблема, Универзитет у Нишу. 2003
Numerical methods.

**ID:** BSc-0018  
**teaching professor:** Аранђеловић Д. Иван  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** mathematics

**goals**

The aims of the course are to familiarize students with: basic concepts of the theory of numerical and functional series and their application in the approximation of functions, causes of computational errors and possibilities of their elimination, classical numerical procedures for determination of approximate values of function (interpolation, extrapolation and approximation), solving of equations and system of equations (Newtonian method), approximate differentiation and integration.

**learning outcomes**

The student should be able to: independently solve various computational problems by applying numerical mathematics procedures, use advanced techniques to solve calculation problems by applying modern software packages.

**theoretical teaching**


**practical teaching**


**prerequisite**

No prerequisites.
learning resources


2. G. V. Milovanović, M. A. Kovačević, M. M. Spalević, Numercal mathematics, selected problems, University of Nis, Faculty of electronics, Niš, 2003.


number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 15
laboratory exercises: 15
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 5
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 21

references
Object oriented programming with java

ID: BSc-0674
teaching professor: Цветковић С. Александар
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written
parent department: mathematics

goals

The aim of this course is to provide an overview of the theoretical foundations of object oriented design. Using Java, theoretical concepts gain practical implementation, which enables understanding of practical and theoretical aspects of object oriented programming.

learning outcomes

The audience of this course will acquire basic theoretical knowledge in object oriented design. In addition, students will gain practical knowledge about object oriented programming in Java. Students are going to use NetBeans and Java SE environment for completing their projects. Practical skills learned should be applicable in any practical computational task in mechanical engineering. Also, Java has strong integration support in many software packages used in mechanical engineering, as the most important we mention Matlab, such that knowledge of Java should increase flexibility in their usage.

theoretical teaching


practical teaching


prerequisite

Advanced computer skills and knowledge of at least one programming language.

learning resources

Software: NetBeans, Java SDK

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 15
laboratory exercises: 10
calculation tasks: 0
seminar works: 5
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 2
check and assessment of seminar works: 2
check and assessment of projects: 0
colloquium, with assessment: 3
test, with assessment: 3
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 20
calculation tasks: 0
seminar works: 10
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

**references**

goals

Starting from the development and characteristics of higher programming languages, this course involves the study of software development and programming methods of the FORTRAN programming language. In addition, students are introduced with the basic methods of Numerical mathematics and how to apply them.

learning outcomes

1. The student should be familiar with the characteristics and specifics of high-level programming languages.

2. He should master theoretical fundamentals of high-level programming languages.

3. He should master programming methods in the FORTRAN programming language.

4. He should be familiar with basic methods of Numerical mathematics and their applications.

theoretical teaching


practical teaching


prerequisite

No prerequisites.
learning resources

I. Aranđelović, Č. Mitrović, S. Minić, G. Lazović, Programming language FORTRAN
Mašinski fakultet, Beograd 2009.

number of hours

total number of hours: 45

active teaching (theoretical)

lectures: 18

active teaching (practical)

auditory exercises: 4
laboratory exercises: 14
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 2
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 2
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 10
laboratory exercises: 40
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 21

references

M. Milačić, R. Radovanović,... Programming - FORTRAN 77, Mašinski fakultet, Beograd 1996.
mechanics

Biomechanics of locomotor system
Mechanics 1
Mechanics 2
Mechanics 3
Student practice B - BSc
Theory of Mechanical Vibrations
Biomechanics of locomotor system

ID: BSc-0086

teaching professor: Лазаревић П. Михаило

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: oral

parent department: mechanics

goals

To introduce students to the application of fundamental principles and laws of biomechanics to understand and study human locomotor system (HLS) - prediction of functional motion / movement, human posture. The formation of the corresponding models of HLS, the possibility of simulations based on them in order to confirm the experimental data, its application to rehabilitation purposes. It allows the potential cooperation with experts in medicine, sports, etc. or work in specialized clinical institutions.

learning outcomes

The student acquires the ability to analyze problems and solutions the ability to predict biomechanical problems of the human locomotor system (HLS) using scientific methods and procedures as well as computer technology and equipment. Linking the basic knowledge of mechanics, physics, anatomy, physiology with application in biomechanics HLS. Implementation of the laws and the principles of mechanics to anatomical structures; a description of how structure affects on the musculoskeletal human movement, motion; analysis of selected mechanisms of injury and performance of mechanisms.

theoretical teaching


practical teaching

Examples of determining anthropometric data. Models of muscle: skeletal, smooth, cardiac, bone models, the spinal column. Examples of solving the problems of kinematics and dynamics of the HLS. Energy analysis and stress analysis: various examples. Example of the cardiovascular, nervous and respiratory systems. Examples of biomechanical models of organs. Instances of models of HLS in the form of kinematic chains-different cases. Mathematical modeling of human body motion and interaction with the environment. Examples of locomotor motion: walking, running, sports movements. Computer methods and techniques in biomechanics (FEM, Matlab,...) with the appropriate application. Biomedical measurements, instrumentation and equipment. Examples of models of prosthetic/orthotic mechanisms of applications in rehabilitation. Various problems of HLS.
prerequisite

desirable courses: Mechanics 1, Mechanics 2, Mechanics 3, Fundamentals of biomedical engineering, Human anatomy and physiology

learning resources

[6] Written abstracts from the lectures (Handouts)
[7] Cyberbotics Webots - software simulation package
[8] MATLAB, CATIA, software packages (CSP, SSO)

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 6
calculation tasks: 7
seminar works: 0
project design: 4
consultations: 3
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 4
colloquium, with assessment: 3
test, with assessment: 3
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 45
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 15
final exam: 30
requirements to take the exam (number of points): 35

references

Mechanics 1

ID: BSc-0001
teaching professor: Младеновић С. Никола
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: mechanics

goals

-to provide students knowledge of the fundamental principles of Statics
-to enable students to master the reduction of system to the simple form and determining conditions of equilibrium of the force system
-to prepare students for solving the problems in different engineering and scientific fields

learning outcomes

-to enable students to solve efficiently the problems of Statics
-to develop in students the ability to apply their knowledge to solve practical problems in high level technical courses which deal with the problems of Statics

theoretical teaching


practical teaching


prerequisite

no

learning resources

[3] Handouts

number of hours

total number of hours: 75
active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 10
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references

Mechanics 2

ID: BSc-0002
teaching professor: Зековић Н. Драгомир
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: mechanics

goals

-to provide students knowledge of the fundamental principles of Kinematics and Particle Dynamics
-to enable students to master the determination of motion, properties of motion of mechanical objects and determination the causes of motions
-to prepare students for solving the problems in different engineering and scientific fields

learning outcomes

-to enable students to solve efficiently the problems of Kinematics and Particle Dynamics
-to develop in students the ability to apply their knowledge to solve practical problems in high level technical courses which deal with the problems of Kinematics and Particle Dynamics

theoretical teaching


practical teaching


prerequisite

Defined by curriculum.

learning resources

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 10
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references

Rusov, L., Kinematics, Naučna knjiga, 1983.
Đurić, S., Kinematics, Faculty of Mechanical Engineering, Belgrade, 1990.
Mechanics 3

ID: BSc-0003
teaching professor: Голубовић Ђ. Зоран
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: mechanics

goals

-to provide students knowledge of the fundamental principles of Particle Dynamics and Mechanical System Dynamics
-to enable students to master the basic theorems and laws of Mechanical System Dynamics, basic concepts of linear vibration of a particle and elements of Analytical Mechanics
-to prepare students for solving the problems in different engineering and scientific fields

learning outcomes

-to enable students to solve efficiently the problems of Particle Dynamics and Mechanical System Dynamics
-to develop in students the ability to apply their knowledge to solve practical problems in high level technical courses which deal with the problems of Kinematics and Dynamics

theoretical teaching


practical teaching


prerequisite
Defined by the curriculum study program

**learning resources**

[4] Handouts

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 10
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

**references**
Đurić, S., Dynamics and theory of Vibrations, Faculty of Mechanical Engineering, Belgrade, 1987.
Student practice B - BSc

ID: BSc-0611
teaching professor: Голубовић Ђ. Зоран
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 1
final exam: seminar works
parent department: mechanics

goals

The goal of the course is introducing students with operation and maintenance of instruments, apparatus and devices in different areas of medicine, especially in clinics and health centers. Professional practice should enable students to easier ad quicker master technical courses, especially in area of early diagnostics of skin cancer and melanoma, ophthalmology, refractive surgery, dentistry, obstetrics,..

learning outcomes

With mastering the course program, students get familiar with:
1. organizational problems of clinics, especially informational processes, databases
2. functioning and maintenance of instruments for measurements, apparatus, and devices for diagnostics and therapy
3. processes of maintenance of instrumentation, apparatus, and devices.

theoretical teaching

Introducing students with implementation of practice, procedures, rules, documents related to protection on work.
Schedule of practice.

practical teaching

Visits to ordinations, hospitals, and health centers.
Getting familiar with realistic work conditions in our country, and establishment of communication system with doctors (adaptation on medical terminology).
Apparatus and devices management for early diagnostics of cancer and melanoma, ophthalmic procedures for constitution of sight.
Interpretation of obtained results from the aspect sensitivity and specificity of obtained results.
Analysis of functioning of apparatus for ultrasound, ECG, EEG,..
Recording and analysis of information pathways, making the data base in clinics, Introducing the medical instrumentation.

prerequisite

Attending practice in the institution.

learning resources

Nanolab 1 and 2 at the Faculty of Mechanical Engineering.

number of hours

total number of hours: 46

active teaching (theoretical)
lectures: 2

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 4
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 20
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 20

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 20
calculation tasks: 0
seminar works: 40
project design: 0
final exam: 30
requirements to take the exam (number of points): 25

**references**
Theory of Mechanical Vibrations

ID: BSc-0012
Teaching professor: Обрадовић М. Александар
Level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
Final exam: oral
Parent department: mechanics

goals

It is necessary to enable the students to independently form and solve linear differential equations of motion of mechanical models of real objects oscillatory moving in different areas of mechanical engineering.

learning outcomes

A learning basic concepts and methods of linear theory of vibrations with an arbitrary finite number of degrees of freedom and elastic bodies with one-dimensional mass distribution, using appropriate computer tools.

theoretical teaching


practical teaching


prerequisite

The subject can take students who have made a condition for entry into the third year of study.

learning resources


handouts


MATLAB software

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 24
laboratory exercises: 6
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 45
laboratory exercises: 15
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

**references**

motor vehicles

Competent practise - Vehicles
Fundamentals of Motor Vehicles
Vehicle Design 1
Vehicle Dynamics
Vehicle performance
Vehicles Safety
Vehicle Systems
Competent practise - Vehicles

ID: BSc-0083

**teaching professor:** Ракићевић Б. Бранислав

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 1

**final exam:** seminar works

**parent department:** motor vehicles

**goals**

Aims of practice consider student’s practical introduction in productive and technological procedures and processes in production of vehicles and other technical systems, and also in specific activities related to systems development and production, their testing, exploitation, maintenance, revitalization, etc.

**learning outcomes**

With this practice, students in particular conditions (vehicle and other systems production, maintenance, testing and exploitation), achieve practical view in production segments of elements, components and Vehicle systems, as well as problems of vehicle/systems mounting as a final product, their exploitation, maintenance and revitalization, according to plan and program of practice, defined related to real possibilities.

**theoretical teaching**

No theoretical classes.

**practical teaching**

Practice have been carried out either through organized visits to laboratories, corporations and factories, either students autonomously choose companies, go there and do some practice. Students activities have been made in frame of realization thesis of practice, and according to guidelines, instructions and explanations, in way of behaviour and subjects of interests during stay in particular company, and especially in way of Practice diary guiding and writing of final Report.

**prerequisite**

No special conditions.

**learning resources**

Instruction for Practice dairy guiding and writing of final Report.

**number of hours**

total number of hours: 46

**active teaching (theoretical)**

lectures: 0

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 45
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 1

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 60
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

**references**

All available literature from finished courses and courses from Motor Vehicle Department.
**Fundamentals of Motor Vehicles**

**ID:** BSc-0426  
**teaching professor:** Ракићевић Б. Бранислав  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** motor vehicles

**goals**

Aims of this course include achieving of competences for conquering of basic specific knowledge and skills needed for overviewing and understanding of problems of motor vehicles, its functioning, basic systems, as well as vehicle’s drag and dynamic characteristics in particular environment conditions.

**learning outcomes**

By conquering of this course, students achieve basic and course-specific capabilities, which are in function of analysis and synthesis of vehicle systems functioning, as well as prediction of vehicle behaviour in characteristic conditions of moving.

**theoretical teaching**

Introduction: (1) Basic terms, vehicle performance, vehicle classification and categorization, vehicle homologation; (2) Concepts of vehicle design, basic systems and elements; (3) Transmission system: construction, tasks and way of functioning – clutch, gearbox, transfer case; (4) Transmission system: construction, tasks and way of functioning – drive axle, final drive, wheels; (5) Characteristic vehicle systems: suspension and steering system, braking system, support structure; (6) Vehicle propulsion: forces in wheel – surface contact, adhesion coefficient, slip coefficient, determination of reactive forces, power transfer from engine to wheels; (7) Transporting vehicles: maximum performances, drag diagram, power characteristics, power balance, acceleration and braking, vehicle stability; (8) Working vehicles: drag diagram, power balance, total efficiency coefficient; (9) Vehicle safety: safety parameters, ecological aspects, mechatronic systems on vehicle (ABS, ASR, ESP, etc.); (10) Vehicle testing: basic aspects of vehicle testing and verification, as well as their systems and components.

**practical teaching**

View of basic vehicle classification and categorization; comments on vehicle homologation; basics of concepts of vehicle design; Power supply (engine); (2) Transmission system – clutch, gearbox, transfer case, driving axle (view of characteristic examples); (3) Basic vehicle systems – wheels, suspension and steering, braking (view of characteristic examples); (4) Laboratory – view of characteristic examples on specific schemes and on real models; (5) Activities of students in calculations of wheel rolling and vehicle moving resistance; (6) Autonomous activities of students in calculations of force distribution in wheel – surface contact; (7) Activities of students in calculations of dynamic reactions, maximum performances and drag characteristics; (8) Autonomous activities of students in calculations of vehicle performances; (9) View of testing and verification of characteristic systems and components problems.

**prerequisite**

No special conditions.
learning resources

1. D. Jankovic: Motor Vehicles – Theory and Design, Faculty of Mechanical Engineering, Belgrade, 1993,

2. D. Jankovic: Solved Problems from Motor Vehicles, Faculty of Mechanical Engineering, Belgrade, 1991,

3. Handouts

4. Laboratory for Motor Vehicles, Institute for Motor Vehicles,

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 15
laboratory exercises: 8
calculation tasks: 5
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 4
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 2
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 10
calculation tasks: 10
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 30

references
D. Jankovic., J. Todorovic, G.Ivanovic, B. Rakicevic: Theory of Vehicle Motion, Faculty of Mechanical Engineering, Belgrade, 2001
N.Janicijevic, D. Jankovic, J. Todorovic: Design of Motor Vehicles, Faculty of Mechanical Engineering, Belgrade, 2000
Vehicle Design 1

**ID:** BSc-0540  
**teaching professor:** Александрић С. Драган  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** motor vehicles

**goals**

Vehicle Design is a complex process, concerned with powertrain, aerodynamics, environmental impact, ergonomics, legislation, materials, production, safety and technology. Course objective is to provide an understanding of the design process of motor vehicles regarding: a) basic requirements being imposed to vehicle and its systems, assemblies, sub – assemblies, and parts, b) influences of vehicle components design on its overall performance, time and cost development, quality of use, and recycling process c) legislation related to the specific vehicle categories. This course aims to develop the broad range of students’ skills and knowledge to be able to understand, recognize, and solve complex issues in vehicle design as a part of challenging automotive industry.

**learning outcomes**

Course outcomes are development of student’s abilities to: a) understand the process of a vehicle design, its relation to design of vehicle systems as well as to be able to design the process to meet desired vehicle/systems characteristics, b) be aware of contemporary issues in vehicle design, c) be able to access various technical information sources, d) be able to function in the team, e) identify key issues, formulate and apply technical knowledge to solve engineering problems related to vehicle design, f) develop written and oral communication skills, g) understand how to use the techniques, skills and modern engineering tools for problems resolving.

**theoretical teaching**

Theoretical lectures are divided into 13 sections: 1) Introduction – a vehicle design and automotive engineering, 2) New materials and vehicle design, 3) Vehicle design and its production, 4) Vehicle construction and its design, 5) Vehicle design from the point of power sources, 6) Vehicle design and power transmission system (friction clutch, manual and automatic gearboxes, drive shaft, final drive transmission and differentials), 7) Vehicle design from the point of braking system, 8) Vehicle design from the point of suspension system, 9) Vehicle design from the point of steering system, 10) Vehicle design from the point of aerodynamics, 11) Vehicle design from the point of ergonomics, 12) Vehicle design from the point of wheels – tires, 13) Vehicle design from the point of its safety.

**practical teaching**

Students carry out a group-engineering project. Project is related to critical analysis of design solutions of the given vehicle and its systems. Students have to collect, analysis, synthesis, and present technical information about the design of the given vehicle with aim to understand influence of real design solutions on the vehicle performance and to propose possible improvements of the vehicle design.

**prerequisite**

There is no precondition.
learning resources

D. Aleksendrić: Vehicle Design 1, Handouts, Faculty of Mechanical Engineering, Belgrade, 2010, DBL.
National and international standards, UN/ECE Regulations, EC Directives, related to motor vehicles.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 5
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 25
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 30
requirements to take the exam (number of points): 30

references
Vehicle Dynamics

**ID:** BSc-0710  
**teaching professor:** Ракићевић Б. Бранислав  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** motor vehicles

**goals**

Aims of this course are offering of overall insight in problems of vehicle dynamics, firstly in specific items of wheel – surface contact. This course is intended to students of Module for Motor Vehicles, and represent an introduction to later considerations of theory of vehicle dynamics. Students are also getting knowledge about incorporating of engine, transmission and driving characteristics into one unit, which is the base for all future activities within Module.

**learning outcomes**

By conquering of this course, students achieve general and specific capabilities, that are in function of analysis and characteristics of wheel – surface contact. Students also achieve basic qualification for competent approach to selection and compatibility of engine and transmission, as well as for finding solutions of particularly problems, with using of scientific tools, methods and procedures.

**theoretical teaching**

Basic terms – vehicle as dynamic system; forces, momentums, reactive forces; wheel and surface characteristics; forces acting on vehicle – static and dynamic reactive forces – vertical, tractive and side forces; maximum performances – speed, acceleration and slope; engine – characteristics of engines, diagram, transferring of engine characteristics from engine to wheels; equation of movement; dynamic characteristics of transporting and working vehicles – drag diagram, power characteristics, power ballance, gear ratios, theoretical and real speed of working vehicles, slip coefficient.

**practical teaching**

Practical lessons are made through public exercise, as preparation for individual papers of students and through practicing some calculations related to all matters studied already in theoretical part. Also, there are autonomous activities of students in calculations within specific areas of course, as well as creation of individual papers, that represent implementation of achieved knowledge for making a dynamic characteristics of vehicles. There is possibility for consultation with teachers, which is preparation for tests and final exam.

**prerequisite**

It has been defined by Module Curriculum.

**learning resources**

1. D. Jankovic, J. Todorovic, G. Ivanovic, B. Rakicevic: Theory of Vehicle Motion, Faculty of Mechanical Engineering, Belgrade, 2001, KPN

2. D. Jankovic: Solved Problems from Motor Vehicles, Faculty of Mechanical Engineering, Belgrade, 1991, KDA
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 4
laboratory exercises: 0
calculation tasks: 19
seminar works: 5
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 2
check and assessment of lab reports: 0
check and assessment of seminar works: 3
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 0
calculation tasks: 20
seminar works: 20
project design: 0
final exam: 30
requirements to take the exam (number of points): 40

references

Thomas D. Gillespie: Fundamentals of Vehicle Dynamics, SAE
Dean Karnopp: Vehicle Stability, Marcel Dakker, 2004
Vehicle performance

ID: BSc-0052
teaching professor: Арсенић М. Живан
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: motor vehicles

goals

Primary goal of this subject is to provide knowledge on modern vehicles characteristics, introduce students to basic principles of vehicle performance determination, terramechanics and vehicle dynamic characteristics calculation using modern theoretical-experimental methods.

learning outcomes

1. Acquisition of theoretical-experimental knowledge in the field of power transmission design. 2. Mastering the contemporary methods in the field of power transmission design. 3. Training of students for computer aided power transmission system design through practical examples.

theoretical teaching

Theoretical course is performed through four sections: 1. Vehicle and vehicle performance fundamentals with review of basic principles of terramechanics. 2. Design and determination of vehicle dynamic characteristics. 3. Definition, design and determination of braking characteristics, vehicle dynamic behavior (overtaking, maneuverability, sideslipping, etc.) and vehicle impact on environment (emission and noise) 4. Definition, design and determination of vehicle, vehicle components and vehicle systems performance (dynamic and static characteristics, tires characteristics, hydraulic power transmission characteristics, hydraulic and pneumatic vehicle components characteristics, friction materials characteristics)

practical teaching


prerequisite

Compulsory subjects: Vehicle systems
Desirable: Vehicle dynamics

learning resources

Lectures in electronic form, practicum for auditory and laboratory exercises and instructions for writing test reports.

number of hours

total number of hours: 75

active teaching (theoretical)
lectures: 30

active teaching (practical)

auditory exercises: 8
laboratory exercises: 17
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 5
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 5
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
Vehicles Safety

**ID:** BSc-0504

**teaching professor:** Ракићевић Б. Бранислав

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** motor vehicles

**goals**

Course objectives are to provide knowledge, skills, and competencies relating to safety-related vehicle systems and fundamental understanding of their operation and performance. Students should be able to understand and solve complex engineering issues in order to increase motor vehicles safety as the most important requirement imposed to automotive industry.

**learning outcomes**

Course outcomes are development of student’s abilities to understand safety-related vehicles systems in terms of their synergistic influence on active, passive, and catalytic safety of motor vehicles. Critical understanding of safety-related vehicle systems and possible uncertainty, ambiguity, and limits in their operation and performance as well as how these may affect driver–vehicle–road safety. Ability to locate, analyse, interpret, criticise, and report on scientific information related to vehicle safety. To be able to employ a range of skills and techniques focused on implementation of solutions for different engineering problems in the field of vehicles safety.

**theoretical teaching**


**practical teaching**

(1) Introduction to a project; (2) Project related to critical analyses of safety aspects of motor vehicles with the aim to collect, analyse, synthesise, and present technical information about active and/or passive and/or catalytic safety of the given vehicle. (3) Calculation tasks related to forces in wheel–surface contact and vehicle stability during braking, driving and turning. (4) Analysis of characteristic examples related to implementation of electronically controlled systems on vehicles. (5) Ecological aspects of vehicle safety. (6) Analysis of regulation and directives related to vehicle safety. (7) Guidelines and instructions for regulations related to safety of special purpose vehicles (ADR – vehicles intended for transport of dangerous goods,...). (8) Visit and demonstration of check procedure of vehicle safety at station for Periodical Technical Inspection.

**prerequisite**

No special conditions.
learning resources

2. N.Janicijevic, D. Jankovic, J. Todorovic: Design of Motor Vehicles, Faculty of Mechanical Engineering, Belgrade, 2000
3. National and international standards, UN/ECE Regulations, EC Directives, related to motor vehicles safety,
4. Handouts,
5. Technical documentation from leading world manufacturers,

number of hours

total number of hours: 75  
active teaching (theoretical)  
lectures: 30

active teaching (practical)  
auditory exercises: 15
laboratory exercises: 5
calculation tasks: 0
seminar works: 0
project design: 10
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 30
final exam: 30
requirements to take the exam (number of points): 36

references
Vehicle Systems

**ID:** BSc-0427  
**teaching professor:** Васић М. Бранко  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** motor vehicles

**goals**

Course objectives are to provide a comprehensive insight into the construction of motor vehicles. Providing knowledge related to constructive characteristics of systems, assemblies, and parts of motor vehicles as well as principles of their operation. Students should be able to understand the basic principles of motor vehicle systems operation, their basic tasks, and influence of construction solutions of motor vehicle systems on its overall behavior.

**learning outcomes**

Course outcomes are development of student’s abilities to understand construction of motor vehicles, the role, characteristics, and principles of motor vehicle systems operation. Critical analysis of operation of motor vehicles systems as well as ability to identify the influence of constructive characteristics of motor vehicle systems, assemblies, and parts on its overall functional characteristics. To be able to employ a range of skills focused on proposals related to redesign and improvement of constructive characteristics of motor vehicle systems, assemblies, and parts.

**theoretical teaching**

Introduction – general about motor vehicles (classification, categorization, unification, and standardization). Vehicles construction and propulsion; Power transmission system (friction clutch, manual and automatic gearboxes, drive shaft, final drive transmission and differentials); Braking system; Tyres; Suspension and steering system; Vehicle body; Electronically controlled systems; Special vehicles.

**practical teaching**

Practical exercises are organized through students work in laboratory. Laboratory work is designed to provide students with possibilities to be practically familiarized with each system of motor vehicle as well as its constructive characteristics and principles of operation.

**prerequisite**

Defined by curriculum of module for motor vehicles.

**learning resources**

1. B. Vasic, V. Popovic: Vehicle systems (at prepress). (KPN)  
2. N. Janicijevic, D. Jankovic, J. Todorovic: Motor Vehicles Construction, Faculty of Mechanical Engineering, Belgrade, 2000 (KDA)  
4. Laboratory exercises are covered by appropriate teaching samples of motor vehicle systems, assemblies, and parts. (EOP-LPS)  
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 20
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references

naval systems

Buoyancy and Stability of Ship 1
Ship Equipment
Ship Structures 1
Ship Systems
Skill Practice B - BRO
Buoyancy and Stability of Ship 1

**ID:** BSc-0093

**teaching professor:** Хофман М. Мильан

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** naval systems

**goals**

To cover the basic knowledge of Naval Architecture connected to ship form, ship buoyancy, stability, and ship hydrostatic calculations (hydrostatic curves and stability). Buoyancy and stability is one of the basic professional courses hence taught in all the departments (faculties) with courses in naval architecture.

**learning outcomes**

Practical knowledge in ship line plan drawing, and in the basic hydrostatic calculations (hydrostatic curves, stability cross curves, righting arm). Ability in solving and analysis of practical engineering tasks connected to ship buoyancy and stability.

**theoretical teaching**


**practical teaching**

Practical problems of ship buoyancy and stability, illustrating the subjects lectured in theoretical syllabus. In addition, students work individually on three classical hydrostatic projects: ship lines drawing, ship hydrostatic curves and ship stability. The projects are completed in the Final Course Report (B.Sc. work), and defended after the sixth semester.

**prerequisite**

The previous study year completed. Semester 5 enrolled.

**learning resources**

[1] Milan Hofman: Extracts from lectures (handouts) /In Serbian/


**number of hours**

total number of hours: 75
active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 15
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 15
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 10
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 40
final exam: 50
requirements to take the exam (number of points): 34

references

Biran, A., Ship Hydrostatics and Stability, Butterworth Heinemann 2003
Buoyancy and Stability of Ship 1

ID: BSc-0693

**teaching professor:** Бачкалов А. Игор

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written+oral

**parent department:** naval systems

**goals**

To cover the basic knowledge of Naval Architecture connected to ship form, ship buoyancy, stability, and ship hydrostatic calculations (hydrostatic curves and stability). Buoyancy and stability is one of the basic professional courses hence taught in all the departments (faculties) with courses in naval architecture.

**learning outcomes**

Practical knowledge in ship line plan drawing, and in the basic hydrostatic calculations (hydrostatic curves, stability cross curves, righting arm). Ability in solving and analysis of practical engineering tasks connected to ship buoyancy and stability.

**theoretical teaching**


**practical teaching**

Practical problems of ship buoyancy and stability, illustrating the subjects lectured in theoretical syllabus. In addition, students work individually on three classical hydrostatic projects: ship lines drawing, ship hydrostatic curves and ship stability. The projects are completed in the Final Course Report (B.Sc. work), and defended after the sixth semester.

**prerequisite**

The previous study year completed. Semester 5 enrolled.

**learning resources**

[1] Milan Hofman: Extracts from lectures (handouts) /In Serbian/

**number of hours**

total number of hours: 75
active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 15
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 15
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 10
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 40
final exam: 50
requirements to take the exam (number of points): 34

references

Biran, A., Ship Hydrostatics and Stability, Butterworth Heinemann 2003
Ship Equipment

**ID:** BSc-0058  
**teaching professor:** Радојчић В. Дејан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 2  
**final exam:** oral  
**parent department:** naval systems

**goals**

The aims of the course are to familiarize students with:
1) basic ship equipment, both with the one found on each ship and with a special one found on some types of ships;
2) essential characteristics of various ship types;
3) regulations concerning ship equipment;
4) the expected development of ship types and their equipment.

**learning outcomes**

Having successfully mastered the teaching contents of Ship equipment, the student should demonstrate fundamental knowledge about:
1) ship equipment;
2) various types of ships and their essential characteristics;
3) the expected development of ship equipment and ship types etc.

**theoretical teaching**

In brief, the course comprises the following teaching units:
1) Deck equipment (anchoring, mooring and steering device)  
2) Cargo access equipment (for vertical and horizontal cargo handling), ship cranes  
3) Safety equipment (rescue, navigational).

The Ship equipment course gains in importance concerning the fact that ships differ in the first place in the installed equipment. The cost of ship is considerably affected by the installed equipment. Ship equipment, on the other hand, is not manufactured in the shipyards but is mainly purchased from specialized manufacturers. That is, to some extent, the reason why the content of the course is mainly encyclopedic in its character.

**practical teaching**

The student is in the focus of practical teaching. Attention is directed to the application of knowledge, previously attained by theoretical teaching, and needed for common engineering practice. Emphasis is placed on classification societies’ rules related to ship equipment. World leading ship equipment manufacturers’ brochures and leaflets provide a source for students to get acquainted with technical characteristics and specificities of equipment installing, depending on the type of ship.

**prerequisite**

There are no prerequisites.

**learning resources**

Extracts from lectures (handouts);  
Yugoslav Register of Shipping rules, Belgrade;
Ship equipment manufacturers’ brochures;
The Internet resources.

**number of hours**

total number of hours: 30

**active teaching (theoretical)**

lectures: 12

**active teaching (practical)**

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 1
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 45
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 50
requirements to take the exam (number of points): 20

**references**

Camac, brod, brodogradnja, Tehnicka enciklopedija, Jugoslavenski leksikografski zavod, Zagreb.
Ship Structures 1

ID: BSc-0071

**teaching professor:** Моток Д. Милорад

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** oral

**parent department:** naval systems

**goals**

The aims of the course are to explain the requirements that hull structure has to meet, and as a result, to gain essential understanding of its general conception, to familiarize the student with the hull structural members to the design details level, to develop student skills to practically apply standard engineering methods used for steel hull structure scantling definition.

**learning outcomes**

A thorough knowledge of general concept and structural members of the welded steel ship hull. The student should be able to practically apply rules for building ships by various classification societies.

**theoretical teaching**

Theoretical teaching is partially encyclopedic in character. The student becomes familiar with the hull basic structural members (terminology presented in both Serbian and English), appearance, basic functions, and loads they undergo during exploitation, method of fabrication, and their versatility and design, depending on ship type and size, applied framing system and the like. On the other hand, both basic principles and methodology for hull scantling definition are considered in parallel, first of all, from the aspect of strength. The history and today’s role of classification societies is considered, their rules and basic aspects of some direct calculations are explained.

**practical teaching**

A detailed prominent example is used to explain the procedure of hull structure scantling definition according to Lloyd’s Register Rules. Within the framework of independent project design the student is dimensioning the following structural members of midship section using "his own" concrete example of the ship: plating and the stiffening system of bottom and inner bottom; plating and the stiffening system of ship sides; plating and the stiffening system of weather and cargo deck; plating and the stiffening system of water-tight bulkheads; pillars in 'tween deck and hold; fore peak structure; after peak structure.
prerequisite

Defined by the Study Program Curriculum

learning resources

[1] Lectures are available in electronic form /In Serbian/
[2] A thorough prominent example of the project
[3] Various classification societies’ rules

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 12
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 14
consultations: 4
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 6
colloquium, with assessment: 0
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 15
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 30
final exam: 50
requirements to take the exam (number of points): 35

references
M. Grubisic: Ship structures /In Serbian/, FSB, Zagreb, 1980.
Ship Systems

ID: BSc-0694  
teaching professor: Бачкалов А. Игор  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 4  
final exam: written+oral  
parent department: naval systems

goals

To cover the basic knowledge of Marine Engineering connected to ship piping and pumping systems.

learning outcomes

Ability in basic design, calculations and analysis of ship piping and pumping systems: bilge, ballast, emergency, heeling, sanitary, tanker, firefighting systems, etc.

theoretical teaching

Ship piping systems: pressure diagram, piping characteristics, characteristics of marine pumps, joint operation of pumps and a piping, suction head problems. Piping armature. Types of marine pumps. Individual ship systems: Bilge system, emergency system, rescue system; Ballast system; Heeling and trim system; Sanitary systems: system of fresh and sea water, system of waste water. Tanker systems: cargo system, stripping system, tank ventilation, tank cleaning, cargo circulation, cargo heating system. MARPOL Regulations. Firefighting systems: fire detection, fire-fighting systems (water, inert gases, foam, halons).

practical teaching

Principle design and calculations of various ship piping and pumping systems. Practical examples of ship systems, illustrating the subjects lectured in theoretical syllabus.

prerequisite

The previous study year completed. Semester 6 enrolled.

learning resources

[1] Extracts from lectures (handouts) /In Serbian/.  
[2] Instructions for projects in buoyancy and stability of ship /In Serbian/.  

number of hours

total number of hours: 45  
active teaching (theoretical)  
lectures: 18  
active teaching (practical)  
auditory exercises: 18
knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 50
requirements to take the exam (number of points): 10

references

Harrington, R.L., Marine Engineering, SNAME 1992
Rowen, A. et al, Introduction to Practical Marine Engineering, SNAME 2005
Ship Systems

**ID:** BSc-0031  
**teaching professor:** Хофман М. Милан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 4  
**final exam:** written+oral  
**parent department:** naval systems

**goals**

To cover the basic knowledge of Marine Engineering connected to ship piping and pumping systems.

**learning outcomes**

Ability in basic design, calculations and analysis of ship piping and pumping systems: bilge, ballast, emergency, heeling, sanitary, tanker, firefighting systems, etc.

**theoretical teaching**

Ship piping systems: pressure diagram, piping characteristics, characteristics of marine pumps, joint operation of pumps and a piping, suction head problems. Piping armature. Types of marine pumps. Individual ship systems: Bilge system, emergency system, rescue system; Ballast system; Heeling and trim system; Sanitary systems: system of fresh and sea water, system of waste water. Tanker systems: cargo system, stripping system, tank ventilation, tank cleaning, cargo circulation, cargo heating system. MARPOL Regulations. Firefighting systems: fire detection, fire-fighting systems (water, inert gases, foam, halons).

**practical teaching**

Principle design and calculations of various ship piping and pumping systems. Practical examples of ship systems, illustrating the subjects lectured in theoretical syllabus.

**prerequisite**

The previous study year completed. Semester 6 enrolled.

**learning resources**

[1] Extracts from lectures (handouts) /In Serbian/.  
[2] Instructions for projects in buoyancy and stability of ship /In Serbian/.  

**number of hours**

total number of hours: 45

**active teaching (theoretical)**

lectures: 18

**active teaching (practical)**

auditory exercises: 18
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 50
requirements to take the exam (number of points): 10

references

Harrington, R.L., Marine Engineering, SNAME 1992
Rowen, A. et al, Introduction to Practical Marine Engineering, SNAME 2005
Skill Practice B - BRO

ID: BSc-0374

teaching professor: Моток Д. Милорад

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 1

final exam: seminar works

parent department: naval systems

goals

The student gains practical experience in the occupational environment where he will pursue his future career. He identifies essential functions of the business system in the domain of design, development and manufacturing as well as the role and tasks of a naval architect within such business system.

learning outcomes

The student should gain practical experience in the way of organizing and functioning of the environment where he will apply the acquired expert knowledge, identify models of communication with his colleagues and business information flows, identify fundamental processes in design, manufacturing, maintenance within the context of his future competence, establish personal contacts and acquaintances he will make use of during his schooling, or when applying for job in the future.

theoretical teaching

practical teaching

Practical teaching involves work in organizations where various activities are performed that have to do with naval architecture. The student chooses thematic unit and manufacturing company or research institution after consulting the Professor. In general, the student is allowed to conduct skill praxis in: shipyards, design and consulting agencies, companies dealing with ship and machinery maintenance, or one of the laboratories at the Faculty of Mechanical Engineering. Skill praxis can be done abroad as well. The student is obliged to keep a diary of skill praxis, where he will describe jobs he is doing, record his conclusions and remarks. After he completes the skill praxis, the student makes a report and provides explanations to the Professor. The report is handed over in the form of a seminar work.

prerequisite

Obligatory for Naval Architecture Module

learning resources
number of hours

total number of hours: 46

active teaching (theoretical)

lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 0

references
physics and electrical engineering

Biophysics
Electrical and Electronics Engineering
Electronics
Electronics and biomedical measurements
Physics and Measurements
Biophysics

**ID:** BSc-0662  
**teaching professor:** Васић-Миловановић И. Александра  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 4  
**final exam:** written  
**parent department:** physics and electrical engineering

**goals**

Introducing students to biophysics fundamentals with emphasis on cell and molecular biology; representation of structure and functions of the bio-systems using descriptive, mathematical and physical modeling. Through physical modeling student is going to learn uses of methods of thermodynamics, kinetics, classical and quantum physics. Through mathematical modeling student could learn theory of information, quantum logic and mathematical description of the system. Student is thus equipped with wide knowledge which can be applied in clinical and scientific research institutions.

**learning outcomes**

Student acquires ability to analyze and model biosystems using different approaches: descriptive, mathematical and physical. Student has mastered necessary knowledge of molecular and cell biology, processing of measurement results and informational technology.

**theoretical teaching**

Introduction to biophysics, subject of research, modeling, system theory. Basics of quantum mechanics. Biophysics of polymers (I): nucleic acids, DNA, RNA; replication, transcription, translation; representation of structure and function using models. Biophysics of polymers (II): conformation of DNA, tRNA, rRNA, primary, secondary, tertiary and quaternary structure of nucleic acids and proteins; structure and functions of some specific proteins (integrin, tubulin etc.). Biophysics of the cell membrane (I): cell membrane model; structure and chemical content; membrane functions; conductivity; transport processes; structure of cytoskeleton. Action potential. Biophysics of the cell (I): cell cycle, cell division, mitosis and meiosis; structure and function of different tubulin ensembles (cilia, flagella, centrioles,...). Biophysics of the cell (II): biochemical and biophysical characteristics of the whole cell; basic characteristics of cell organelles. Biophysics of the muscle tissue: structure of skeletal muscle, structure and function of individual muscle fiber; contractions of skeletal musculature; activity of the actin and myosin elements using ATP as the source of energy.

**practical teaching**

prerequisite

Necessary: Physics
Desirable: Systemic anatomy and physiology for engineers, Fundamentals of biomedical engineering

learning resources

1. Written course material (handouts)
2. Instruments and equipment of the Biomedical Engineering laboratory
3. MATLAB software
4. Resources of the laboratories from Biological faculty

number of hours

total number of hours: 45

active teaching (theoretical)

lectures: 18

active teaching (practical)

auditory exercises: 0
laboratory exercises: 6
calculation tasks: 12
seminar works: 1
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 3
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 3
final exam: 2

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 45
laboratory exercises: 0
calculation tasks: 0
seminar works: 15
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references
Charles R. Cantor, Paul R. Shimel, Biophysiccal chemistry, part I, San Francisco 1979
Electrical and Electronics Engineering

ID: BSc-0026
teaching professor: Кандић Б. Драган
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: physics and electrical engineering

goals

The aim of the course is to familiarize the students with basic laws of electrical and electronics engineering and to develop their competence for acquisition of more advanced academic knowledge and practical skills in scientific, professional and applied areas of mechanical engineering relying on electrical and electronics engineering. The students are introduced into basic phenomena, devices and circuits encountered in electrical engineering, and scientific methods for their analysis and practical measurements.

learning outcomes

Having successfully mastered the teaching contents of Electrical and Electronics Engineering, the student should be able to qualitatively pursue his scientific career and profession, manipulate methods of analysis and measurements in electrical engineering, anticipate the solutions and perceive the outcomes, acquire understanding of research and practical methods in the fields he can adequately apply in concrete problem-solving in mechanical engineering.

theoretical teaching

- Electrostatics (electric charge, Coulomb’s law, electric field, potential and voltage, Gauss’s law with applications, conductors and insulators in electric field, dipoles, polarization of dielectrics, capacitors, energy of field, forces and pressures).
- DC currents (current field and its characterization, electrolysis, continuity equation and I Kirchoff’s law, Ohm’s and Joule’s law, resistors, emf, origin and kinds, electric generators, types, characteristics and transformations, electric circuits and networks, work and power, II Kirchoff’s law, theorems of linear, time-invariant DC networks, analysis methods).
- Electromagnetism (magnetic field and its characterization, fundamental quantities and laws - Ampere’s law of magnetic force between current elements, Biot-Savart’s and Laplace’s law with applications, magnetic flux and its conservation, Ampere’s law, substance in field, law of total current, magnetic circuit, Kapp-Hopkinson’s law with applications, electromagnetic induction, inductance coefficients, energy of magnetic field, forces and pressures). Principles of electromechanic conversion.
- Transient analysis of basic RLC circuits and networks. Regular and nonregular commutation.
- Alternating currents (generation, characterization, phasor and symbolic calculus, power, methods of network analysis). Mono-phase transformers. Three-phase systems.
- Elements of electronics (semiconductors, diodes, BJTs, Op-Amps, selected applications).

practical teaching

Auditorial exercises involve presentation of numerical examples and problems tightly compliant with theoretical teaching.

Three laboratory exercises are scheduled:

2. Induced emfs. Transient processes in RLC circuits
3. Testing of Kirchoff’s laws in monophase AC circuits. Load power measurement.

prerequisite

Defined by the Study Program Curriculum

learning resources

2. P. Miljanić: Electrical engineering, FME, Belgrade, 1996 /In Serbian/
6. Several types of printed extracts from lectures ("handouts") /In Serbian/. Also, available on: http://www.mas.bg.ac.rs/obrazovanje/katedre/fizika-elek/vesti.html
7. Licensed software, LT Spice IV, LogiSim and student-versions of other software.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 25
laboratory exercises: 3
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 3
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 9
test, with assessment: 0
final exam: 3

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 50
laboratory exercises: 15
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references

Electronics

**ID:** BSc-0250  
**teaching professor:** Кандић Б. Драган  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** physics and electrical engineering

**goals**

The aim of the course is to familiarize the students with basic laws of electronics engineering and to develop student competence for acquisition of more advanced academic knowledge and practical skills in scientific, professional and applied areas of mechanical engineering relying on electronics. The student is introduced into basic devices, circuits and systems encountered in electronics engineering and scientific methods for their analysis and practical measurements.

**learning outcomes**

Having successfully mastered the teaching contents of Electronics, the student should be able to qualitatively pursue his scientific career and profession, manipulate methods of analysis and measurements in electronics, anticipate the solutions and perceive the outcomes, acquire an understanding of research and practical methods in the fields he can adequately apply in concrete problem-solving in mechanical engineering.

**theoretical teaching**

-Definition of electronics and a brief historical overview. Electronic signals and systems
-Elements of semiconductor physics (semiconductor crystal structure, intrinsic and extrinsic semiconductors, basic transport phenomena)
-PN-junction (physical structure, open-circuited and operation with applied direct and inverse polarization, capacitance of depletion layer, diffusion capacitance, voltage breakdown)
-Semiconductor diodes (current-voltage characteristic, models for small and large signals, temperature characteristics, distribution of currents and voltages in diode circuits, switching operation, special purpose diodes-Zener, Schottky, tunnel and PIN, applications)
-Bipolar junction transistors (principle of operation, distribution of currents, amplifying property, large-signal model, current-voltage characteristics, biasing, small-signal operation and models, high-frequency operation, basic BJT amplifier configurations, breakdown and temperature effects, switching operation)
-Field-effect transistors-JFET and MOSFET (principle of operation, current-voltage characteristics, biasing, small-signal operation and models, switching operation)
-Amplifiers (transfer-function, equivalent circuit, feedback, frequency-response). Operational amplifiers (properties, common circuits and applications in linear and nonlinear signal processing)
-Oscillators (sinusoidal and relaxation, analysis, types, amplitude an frequency stabilization)
-Power amplifiers (with BJT, transformer-coupling and complementary pair)
-Components of power electronics (thyristor, diac and triac, application in power-regulation circuits)
-Elements of digital electronics (number systems, Boolean algebra, switching functions, basic logic gates, combinatorial and sequential circuits)
-A/D and D/A converters.
practical teaching

Auditorial exercises involve presentation of numerical examples and problems, all complying with theoretical teaching.

Four laboratory exercises are scheduled:

1) Common diode applications (rectifiers, limiters and clamps)
2) One-stage BJT common-emitter voltage amplifier (operating-point adjustment, recording of amplitude-frequency response)
3) Selected Op-Amp circuits in linear and nonlinear signal processing
4) Logic gates. Selected combinatorial circuits. Counters.

The intense application of LT Spice IV, LogiSim and student version of Multisim is conceived in both types of exercises.

prerequisite

Defined by the Study Program Curriculum.

learning resources

7. Printed extracts from lectures ("handouts") /In Serbian/.
8. Licensed software, LT Spice IV, LogiSim and other student-version software.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 24
laboratory exercises: 4
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks
check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 8
final exam: 3

assessment of knowledge (maximum number of points - 100)

feedback during course study: 4
test/colloquium: 50
laboratory exercises: 16
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references

Electronics and biomedical measurements

ID: BSc-0030

teaching professor: Љукић М. Петар

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: physics and electrical engineering

goals

Introducing to fundamentals of Electronics, the most common electron components and circuits. Presentation of the basic medical measurements and diagnostically methods. The focus is on the operation of standard biomedical equipment with brief description of device construction. The subject educates engineers to improve still existing and develop new biomedical devices.

learning outcomes

By attending the course, students will be educated to understand and analyze problems concerned with operation and usage of basic biomedical instrumentation and equipment. This course educate students to connect basic principals of electronics, physics and medicine and to practically implement them into modern medical equipment.

theoretical teaching


practical teaching


Examples - Electric circuits with operational amplifier.

Principles of medical measurements - methods. Measurement of blood pressure, measurement of blood and gas flow - examples. The measuring of the breath amount (volume) and breath speed (flow) - discussion. Programmable electronic muscle stimulator.

prerequisite

It is defined by the curriculum of the module.

learning resources


[4] Handouts

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 25
laboratory exercises: 0
calculation tasks: 0
seminar works: 3
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 3
check and assessment of projects: 0
colloquium, with assessment: 3
test, with assessment: 4
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 0
final exam: 60
requirements to take the exam (number of points): 20

**references**

Physics and Measurements

**ID:** BSc-0025  
**teaching professor:** Васић- Миловановић И. Александра  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** physics and electrical engineering

**goals**

Understanding of basic physical concepts and laws. Aspects of practical application of these laws. Development of problem solving skills through examples from engineering practice and everyday life by applying basic physics laws. Introduction to main devices and methods of direct and indirect measurements in physics and techniques. Understanding of contemporary methods for measurement result processing.

**learning outcomes**

Final outcome: 1) interconnection of different teaching units within the course and reviewing of general physical principles in different fields; 2) logical and critical reasoning while dealing with natural and technical phenomena; 3) utilization of dimensional analysis and methods for problem solving; 4) independent and team experimental work; 5) estimation of measurement uncertainty.

**theoretical teaching**


**practical teaching**

Examples of determination of trajectory, path, velocity and acceleration of the body for motions along a straight and curved line. Application of Newton's second law and conservation of mechanical energy for different types of motion, especially for oscillations. Considering the changes in the system energy under the influence of conservative and nonconservative forces and determination of performed work. Application of conservation of momentum. Solving problems in the field of physics of ideal fluids and gases. Application of energy conservation for stationary flow of ideal fluids, as well as in thermophysics for determination of performed work during different thermodinamical processes. Examples in the field of propagation of transverse and longitudinal mechanical waves. Standing waves in confined environment. Resonance. Wave optics (propagation, refraction, reflection, interference and diffraction of waves in optical part of spectrum). X-ray diffraction on crystal.

**prerequisite**

Defined by the curriculum of study program/module.

**learning resources**

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 20
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 3
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 3
final exam: 3

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 50
laboratory exercises: 15
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

**references**
Aničin Božidar, Lectures in Physics 1, Faculty of Mechanical Engineering, Belgrade, various editions.
Olga Žižić, Lectures in Physics 2, Faculty of Mechanical Engineering, Belgrade, various editions.
Olga Žižić, Physics - Collection of Solved Problems, Faculty of Mechanical Engineering, Belgrade, various editions.
process and environmental protection engineering

Equipment in process industry
Fundamentals of risk engineering and fire safety
Introduction in process and environmental engineering
Mechanical Design of Process Equipment
Pipeline and fittings
Processes and equipment in environmental engineering
Skill practice B - PTH
Equipment in process industry

ID: BSc-0033

teaching professor: Генић Б. Србислав

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: process and environmental protection engineering

goals

Analyzing complex technological processes and their breakdown into individual operations. Understanding the basic operations in process industry. Acquiring basic knowledge of mechanical, hydromechanical, thermal, diffusion, chemical and biological operations. Understanding the basics of transport of fluids and solids, as well as supporting operations in every technological process. Equipment for Unit Operations.

learning outcomes

Ability of analyzing complex processes in process industry. Acquisition of basic concepts about the characteristics of the equipment used for mechanical, hydro, thermal, diffusion, chemical and biochemical operations. Understanding the role of additional equipment in process industry.

theoretical teaching

Unit operations in process industry and classification of equipment.
Mechanical operations and equipment
Hydromechanical operations and equipment
Heat transfer operations and equipment
Mass transfer operations and equipment
Chemical reactions and reactors
Biochemical operations and equipment
Transport and storage of fluids
Transport and storage of solids
Economic analysis of process plants

practical teaching

Examples of mechanical operations and equipment
Examples of hydromechanical operations and equipment
Examples of heat transfer operations and equipment
Examples of mass transfer operations and equipment
Examples of chemical reactions and reactors
Examples of biochemical operations and equipment
Examples of transport and storage of fluids
Examples of transport and storage of solids
Examples of economic analysis of processing plants

prerequisite

Entered the sixth semester.

learning resources

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 10
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 21

**references**

Fundamentals of risk engineering and fire safety

**ID:** BSc-0620  
**teaching professor:** Генић Б. Србислав  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 4  
**final exam:** written+oral  
**parent department:** process and environmental protection engineering

**goals**

Introduce students to: risk analysis, risk management and risk engineering, regulations on fire prevention, preventive fire protection, fire extinguishers, firefighting tactics and equipment to fire fighting and smoke removal for installation.

**learning outcomes**

Students will be familiar with risk analysis, risk management and risk engineering, as well as with modern fire-fighting procedures and technical measures of preventive fire protection.

**theoretical teaching**

Review of basic concepts of risk анализис, risk management and risk engineering  
Hazards: toxicity, flammability, explosion, noise  
Sources of ignition - the impact of the temperature, pressure and mixture composition on the ignition  
Calculations of index of fire, explosion and toxic pollution  
The regulations on fire protection  
EquipmentT for extinguishing - Classification and application.  
Technical and other preventive measures for fire protection and their application  
General fire hazards, fire-sensitive technology  
Fire prevention technologies - The classification of objects according to fire risk  
The basic elements of the design system for the prevention and extinguishing  
Fire load calculation of buildings

**practical teaching**

Application of regulations on fire protection  
Fire extinguishers  
Stable fire extinguishing systems: water, foam, etc.  
Installations for the removal of smoke  
General fire hazards, fire-sensitive technology - Fire hazards and protection measures in various industries  
Fire load calculation of buildings

**prerequisite**

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**learning resources**

S. Genić, I. Arandjelovic, R. Rajic, B. Nikolic, Fundamentals of Fire Safety (script)  
S. Genić, I. Arandjelovic, R. Rajic, B. Nikolic, Handbook of Fire Safety (script)
M. Eric, Fire protection and prevention

**number of hours**

total number of hours: 45

**active teaching (theoretical)**

lectures: 12

**active teaching (practical)**

auditory exercises: 18
laboratory exercises: 6
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 6
final exam: 3

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 0

**references**

S. Genić, I. Arandjelovic, R. Rajic, B. Nikolic, Fundamentals of Fire Safety (script)
S. Genić, I. Arandjelovic, R. Rajic, B. Nikolic, Handbook of Fire Safety (script)
M. Eric, Fire protection and prevention
Introduction in process and environmental engineering

ID: BSc-0081

teaching professor: Јововић М. Александар

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: process and environmental protection engineering

goals

Process technique and environmental protection are associated with the request that the technical solutions make sense only when provide a sustainable development. Students get knowledge about the basic production processes and devices in industry and environmental protection measures during the work of these processes and apparatus. Visits are aimed at getting acquainted with real industrial plants and processes, laboratory work, measurement methods, processes, design and construction processes and equipment.

learning outcomes

Understanding the terminology related to basic operation in processing industry and the problems related with environment. Acquiring the ability to analyze complex technological processes. Setting up the basic equations of balance. Solving concrete problems in engineering practice.

theoretical teaching

Introduction, Brief history and profession of the Department, a list of items that are recommended for further hearing in the field of process engineering, environmental protection importance and the role of engineers, Environmental Management, Sustainable Development, Types of process operations, Mechanical and hydro-mechanical operation, heat and diffusion operation, chemical and biochemical operations, auxiliary operations, industrial furnaces and boilers, appliances, machinery, equipment, The causes of environmental problems, Legislation and regulation, greenhouse effect, acid rain, Scientific basis of environmental protection, Physics and chemistry of the environment, atmospheric sciences, ecology basics Technology and control, Air pollution, Water resource management, supply, water pollution, collection and wastewater treatment, Waste management, Noise and vibration, Ionizing radiation, Construction of equipment and machinery, Plant design, Impact assessment and risk, Development of studies and analysis, Data collection, Presentation of the results.

practical teaching

Visit an industrial plant, Touring and introducing with petroleum refining industry, chemical and petrochemical industry, food industry, etc, Understanding the processes and equipment, Environmental protection and safety at work, Procedures and processes, Management at production company, Visit to laboratories, Visit the authorized and accredited laboratories in the field of process equipment and environmental media and pollution, Introduction to the method, procedures, standards and methods,
Visit design-consulting company, visiting and learning about company operations, types of work that can work engineer of process technology, insight essential knowledge to work in the company, company management and projects, marketing and advertising, contracting, design, documentation, construction projects, field work, supervision.

**prerequisite**

There are no requirements to attend courses, in terms of the previously passed courses.

**learning resources**

Considering that for the course is not yet completed a textbook, materials for lectures are submitted to students in printed and electronic form.

**number of hours**

Total number of hours: 75

**active teaching (theoretical)**

Lectures: 30

**active teaching (practical)**

Auditory exercises: 0
Laboratory exercises: 0
Calculation tasks: 0
Seminar works: 10
Project design: 0
Consultations: 20
Discussion and workshop: 0
Research: 0

**knowledge checks**

Check and assessment of calculation tasks: 0
Check and assessment of lab reports: 0
Check and assessment of seminar works: 0
Check and assessment of projects: 0
Colloquium, with assessment: 0
Test, with assessment: 10
Final exam: 5

**assessment of knowledge (maximum number of points - 100)**

Feedback during course study: 10
Test/colloquium: 60
Laboratory exercises: 0
Calculation tasks: 0
Seminar works: 0
Project design: 0
Final exam: 30
Requirements to take the exam (number of points): 21

**references**
Mechanical Design of Process Equipment

ID: BSc-0087

teaching professor: Петровић Љ. Александар

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: process and environmental protection engineering

goals

Objective of the course is that students acquire academic skills and academic competencies for selection and calculation of strength of high or low pressure vessels, apparatus and equipment. By performing students’ projects, they acquire creative and specific practical skills that qualify them to perform professional work in the field of process equipment design. Through the laboratory experiments and exercises, students gain knowledge of testing and exploiting process equipment.

learning outcomes

By successful completion of the study program student acquires the following skills: analysis, synthesis and prediction of solutions and consequences; development of critical thinking and self-critical approach; application of knowledge in practice; professional ethics; correlation of knowledge from different fields and their applications; development of skill and proficiency in the use of knowledge in field of process equipment.

theoretical teaching


practical teaching


prerequisite

Students enrolled in third year of bachelor studies; passed exams from the first year of studies.

learning resources

HANDOUTS,

number of hours

376
total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 20
laboratory exercises: 2
calculation tasks: 0
seminar works: 0
project design: 8
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 6
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 20
laboratory exercises: 5
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 50
requirements to take the exam (number of points): 30

references

Handouts
Pipeline and fittings

ID: BSc-0082
teaching professor: Петровић Љ. Александар
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: process and environmental protection engineering

goals

Objective of the course is that students acquire academic skills and academic competencies for selection and calculation of pipelines and pipeline fittings. By performing students’ projects, they acquire creative and specific practical skills that qualify them to perform professional work in the field of pipeline design. Through the laboratory experiments and exercises, students gain knowledge of testing and exploiting process equipment.

learning outcomes

By successful completion of the study program student acquires the following skills: analysis, synthesis and prediction of solutions and consequences; development of critical thinking and self-critical approach; application of knowledge in practice; professional ethics; correlation of knowledge from different fields and their applications; development of skill and proficiency in the use of knowledge in field of pipelines and pipeline fittings.

theoretical teaching

1. Classification and marking of pipelines; Input data for design; Description of activities in the design phase; Materials for pipelines; Graphical documentation. 2. Calculation of the thickness of pipe wall, pipe elbow and other fittings, plastic and elastic deformations, distribution of loads from the internal pressure; Flanges; Welding. 3. Safety equipment. Pipelines supports, Distance between supports, Pipeline testing. 4. Self-compensation, axial compensator, pipelines not laid in canals, selection and calculations. 5. Pipelines laid and not laid in canals, Systems of pipelines, pipeline systems not laid in canals. 6. Thermo-isolation and protection against corrosion. 7. Purpose and classification, plug valves (passing, three-way and four-way valves and ball valves) regulation characteristics. 8. Safety valves, safety valve’s calculation and selection. 9. Condensation and Moisture Separators, Filters, air release valve. 10. Valve functions, calculation and selection.

practical teaching


prerequisite

Students enrolled in second year of bachelor studies; passed exams from the first years of
learning resources

HANDOUTS,

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 20
laboratory exercises: 2
calculation tasks: 0
seminar works: 0
project design: 8
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 6
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 20
laboratory exercises: 5
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 50
requirements to take the exam (number of points): 30

references

Handouts
Processes and equipment in environmental engineering

**ID:** BSc-0650  
**teaching professor:** Јововић М. Александар  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 2  
**final exam:** written  
**parent department:** process and environmental protection engineering

**goals**

Students get knowledge about the technical basis of environmental management. The main goal is to master the skills to recognize problems that occur in the work of industrial and power plants. Laboratory exercises aimed at introduction to laboratory work, the methods of measurement, process control.

**learning outcomes**

Successful completion of the study program the student receives general abilities that are used for professional quality performance. Get ability to analyze complex technological processes and their impact on the environment. Setting up the basic equations of balance.

**theoretical teaching**

Characteristics and comparison of processes and plants for the purification of gases,  
Air protection,  
The values and ways of reducing emissions of polluting components of the typical processes and plants,  
Water protection,  
Characteristics and allowable concentrations of pollutants of components, determine the concentration of polluting components, processes, tools, equipment for sewage treatment,  
The processes and equipment in waste management,  
Collection, transport, waste separation at source and processing, recycling, thermal and biological treatment, disposal

**practical teaching**

Introduce students to different types of plants in the field of environmental protection through slides, films and foils,  
The calculation of polluting components,  
Monitoring air pollution,  
The distribution of polluting components in the environment,  
Calculation of material and heat balance devices for the separation, Selection of separation of solid and gaseous pollutants from waste gas components,  
Calculation of concentration and flow of pollutants in waste water components, calculation of material and heat balance device, Selection of Wastewater Treatment  
Calculation of growth of municipal solid waste, Equipment selection for waste treatment, Selection and sizing of equipment to prevent hazards due to the appearance of noise and vibration,  
Determining the concentration of SO2 in the flue gases based on sampling of flue gases and the measured values,  
Determination of solid particles in flue gases,  
Preparation and public presentation of seminar papers with discussions.

**prerequisite**
There are no requirements to attend courses, in terms of the previously passed courses.

**learning resources**

Considering that for the course is not yet completed a textbook, materials for lectures are submitted to students in printed and electronic form.
Laboratory measurement system (LMS)- apparatus for determining components of pollutants in flue and waste gases.

**number of hours**

total number of hours: 30

**active teaching (theoretical)**

lectures: 8

**active teaching (practical)**

auditory exercises: 11
laboratory exercises: 2
calculation tasks: 0
seminar works: 2
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 1
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 15
laboratory exercises: 10
calculation tasks: 0
seminar works: 15
project design: 0
final exam: 50
requirements to take the exam (number of points): 30

**references**
Skill practice B - PTH

ID: BSc-0501
teaching professor: Станојевић М. Мирослав
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 1
final exam: seminar works
parent department: process and environmental protection engineering

goals

Practical experience and a student lounge in the process industry companies in which the student will realize his professional career. Identifying the basic functions of the business system in the field of design, development and production, as well as the role of engineers and process engineering tasks in such a business system.

learning outcomes

Students get practical experience on the organization and functioning of the environment in which they will apply their knowledge in their future professional career. Student identifies models of communication with colleagues and business information flows. The student recognizes the basic processes in the design, manufacture, maintenance, process systems in the context of his future professional competence. Students establish the personal contacts and relationships that will be able to use at school or entering into future employment.

theoretical teaching

The role and importance of professional practice - process engineering, engineering in environmental protection. Basic principles of devices and machines of process equipment. Fundamentals of technological processes in the field of process engineering. The basics of designing process systems. The basics of distributions main and auxiliary fluids.

practical teaching

Practical work involves working in organizations that perform various activities related to process engineering. Selection of thematic areas and commercial or research organizations carried out in consultation with the concerned teacher. Generally a student can perform the practice in manufacturing organizations, project and consultancy offices, and other organizations that have contact with the process industries. During practice, students must keep a diary in which they should enter a description of the tasks performed, the conclusions and observations. Following the practice must make a report to defend the subject teacher. The report is submitted in the form of the paper.

prerequisite

It is recommended only for students of Process Engineering.module.

learning resources


number of hours

total number of hours: 46
active teaching (theoretical)

lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 0

references
production engineering

Advanced biomedical software
Biomedical Software Basics
CAD/CAM SYSTEMS
CAD/CAM SYSTEMS
Computer Graphics
COMPUTER GRAPHICS
Computer simulation and artificial intelligence
Cybernetics
Machine tools
Manufacturing Technology
Production technology and metrology
Quality of Engineering Education
Shipbuilding Technology
SKILL PRAXIS B – ПРО
TOOLS AND FIXTURES
Advanced biomedical software

ID: BSc-0580  
teaching professor: Божић А. Божица  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 2  
final exam: written  
parent department: production engineering  

goals

Introducing students to software packages MATLAB and EXCEL at a higher level. Increasing knowledge gained in the course Fundamentals of biomedical software. Forming models of biological systems in the Simulink software package. Introducing students to basic principles of processing, analysis and display of biological signals in these software packages.

learning outcomes

Attending the course students become capable of processing and analysing data and forming biological systems and processes model.

theoretical teaching


practical teaching

Microsoft Excel experimental data fitting; Least-square method; Examples where built-in functions and commands are used: Trendline, SLOPE, INTERCEPT, interpolation and extrapolation, FORECAST, LINDEX, LOGEST, TREND, GROWTH, Analysis Toolpak. Polinomial roots finding, solving systems of nonlinear equations, curve fitting, optimization problems with Goal Seek and Solver. Statistical analysis with Microsoft Excel: functions AVERAGE, DEVSQ, FREQUENCY, STDEV, TTEST, TINV, TDIST. Solving symbolic mathematical problems using MATLAB. Analytical modeling of second order mechanic systems: second order system (mass-spring-damper). Development of the standalone application and Graphical User Interface components: simple calculator using MATLAB. System modeling with SIMULINK: simulating the demo model. Running the simulation. Modifying simulation parameters. Importing data from the MATLAB Workspace. Exporting simulation data to the MATLAB Workspace. Solving differential equations. Simple mechanical system models: mass-
spring-damper, cascade of mass-spring system, mechanical accelerometer. Modeling of biological and physiological systems: PNEUMA - modeling of human cardiorespiratory system, modeling of blood glucose level regulation process.

**prerequisite**

Necessary: Programming, Computer software tools, Biomedical Software Basics

**learning resources**


**number of hours**

total number of hours: 30

**active teaching (theoretical)**

lectures: 9

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 8
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 4
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 4
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 50
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 40

**references**
Biomedical Software Basics

ID: BSc-0573

**teaching professor:** Божица А. Божица

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 2

**final exam:** written

**parent department:** production engineering

**goals**

Introducing students to the basic software packages for numerical analysis, data processing, mathematical modeling and graphical visualization of results. Solving specific problems in biomedical engineering and scientific practice.

**learning outcomes**

Attending the course, students are trained for analyzing and processing data obtained from different measurements and numerical modeling of systems and processes.

**theoretical teaching**


**practical teaching**

equation using Gauss elimination method, ideal gas volume computing. Complex function plots.

**prerequisite**

Necessary: Programming, Computer software tools

**learning resources**


**number of hours**

total number of hours: 30

**active teaching (theoretical)**

lectures: 9

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 8
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 4
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 4
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 50
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 40

**references**
CAD/CAM SYSTEMS

ID: BSc-0072

Teaching professor: Бојанић О. Павао

Level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

Final exam: written

Parent department: production engineering

Goals

1. Awareness that efficiency of computer use in engineering activities can be accomplished only through integrated systems, such as CAD/CAM systems used in the area of product design and design of manufacturing technology
2. Mastery of theoretical foundations of contemporary CAD/CAM systems structure and operation
3. Acquisition of practical knowledge about using CAD/CAM systems and numerically controlled machine tools programming

Learning outcomes

1. Fundamental knowledge of computer use in the area of product geometrical modeling
2. Fundamental knowledge of computer use in design of manufacturing technology
3. Fundamental knowledge of computer use in numerically controlled machine tools programming
4. Skill to apply contemporary CAD/CAM systems in product design and design of manufacturing technology
5. Practical experience in preparing programs for numerically controlled machine tools

Theoretical teaching

Theoretical teaching comprises two teaching units:
1. Problem of work-piece geometrical modeling as a basis of CAD system. Internal, computerized and model development of work-piece means to create prerequisites for using that model as a basis for design of manufacturing technology and for generating control information (CAM) for numerically controlled machine tool. In addition to using conventional numerical control technology, this teaching unit is also considering the application of work-piece computer model as a basis of "rapid prototyping" by material addition technology
2. Basis, structure and application of conventional languages for programming numerically controlled machines are presented. Studies of geometry description, kinematics, technological demands and post-processor commands lead to the contents and structure of control information for modern computer controlled machine tools. Syllabus also includes studying of APT and EXAPT languages

Practical teaching

Exercises are organized in computer rooms and at the Laboratory for machine tools. Using available CAD/CAM software, such as ProEngineer, Autodesk Inventor, Catia, Solid Edge and the like, the student will master the skill of work-piece geometrical model development as well as the skill of generating tool path in making NC program for numerically controlled machine tools. Also, the student will write NC program in APT. Final exercise involves the development of NC program for a concrete work-piece on a concrete machining center. Work-piece is manufactured at the Laboratory for machine tools

Prerequisite
This course is strongly linked to the area of production engineering and there are no prerequisites for course attendance

learning resources

Lectures in e-form [In Serbian]. Book: APT language (in serbian. Faculty for Mechanical Engineering), Instructions for performing laboratory exercises [In Serbian]. Instructions for project design [In Serbian]. CA workstation (CAD, CAM, CAE, CAPP, ...), CAD/CAM software package

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 9
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 40

references
CAD/CAM SYSTEMS

ID: BSc-0664

teaching professor: Пузовић М. Радован

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: production engineering

goals

1. Awareness that efficiency of computer use in engineering activities can be accomplished only through integrated systems, such as CAD/CAM systems used in the area of product design and design of manufacturing technology
2. Mastery of theoretical foundations of contemporary CAD/CAM systems structure and operation
3. Acquisition of practical knowledge about using CAD/CAM systems and numerically controlled machine tools programming

learning outcomes

1. Fundamental knowledge of computer use in the area of product geometrical modeling
2. Fundamental knowledge of computer use in design of manufacturing technology
3. Fundamental knowledge of computer use in numerically controlled machine tools programming
4. Skill to apply contemporary CAD/CAM systems in product design and design of manufacturing technology
5. Practical experience in preparing programs for numerically controlled machine tools

theoretical teaching

Theoretical teaching comprises two teaching units:
1. Problem of work-piece geometrical modeling as a basis of CAD system. Internal, computerized and model development of work-piece means to create prerequisites for using that model as a basis for design of manufacturing technology and for generating control information (CAM) for numerically controlled machine tool. In addition to using conventional numerical control technology, this teaching unit is also considering the application of work-piece computer model as a basis of "rapid prototyping" by material addition technology
2. Basis, structure and application of conventional languages for programming numerically controlled machines are presented. Studies of geometry description, kinematics, technological demands and post-processor commands lead to the contents and structure of control information for modern computer controlled machine tools. Syllabus also includes studying of APT and EXAPT languages

practical teaching

Exercises are organized in computer rooms and at the Laboratory for machine tools. Using available CAD/CAM software, such as ProEngineer, Autodesk Inventor, Catia, Solid Edge and the like, the student will master the skill of work-piece geometrical model development as well as the skill of generating tool path in making NC program for numerically controlled machine tools. Also, the student will write NC program in APT. Final exercise involves the development of NC program for a concrete work-piece on a concrete machining center. Work-piece is manufactured at the Laboratory for machine tools
prerequisite

This course is strongly linked to the area of production engineering and there are no prerequisites for course attendance.

learning resources

Lectures in e-form [In Serbian]. Book: APT language (in serbian. Faculty for Mechanical Engineering), Instructions for performing laboratory exercises [In Serbian]. Instructions for project design [In Serbian]. CA workstation (CAD, CAM, CAE, CAPP, ...), CAD/CAM software package.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 9
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 40

references
Lectures in e-form [In Serbian].
Book: APT language (in serbian).
ID: BSc-0663
teaching professor: Јаковљевић Б. Живана
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: production engineering

goals

The objective of this course is that students: obtain fundamental knowledge and skills necessary for advanced application of computer graphics in various engineering activities; master theoretical and mathematical basics of computer graphics; gain necessary knowledge, skills and practical experiences in development of software applications based on computer graphics; understand basic functional principles and acquire knowledge for advanced usage of computer aided design tools.

learning outcomes

The outcomes of the course are: fundamental knowledge in the field of computer graphics and the methods based on computer graphics; knowledge, skills and practical experiences in application of computer graphics principles in development of software applications; knowledge necessary for advanced application of computer aided design tools (e.g. design of freeform curves and surfaces); knowledge, skills and practical experience in generation of realistic images in three-dimensional graphics and animation

theoretical teaching

1. Introduction to computer graphics: vector and raster graphics, color models, hardware components for image display
2. Modeling in computer graphics: the role of modeling in graphics pipeline, camera model, coordinate systems in computer graphics, hierarchical modeling, B representation
3. Two-dimensional transformations: translation, rotation, scaling, mirror reflection, order of transformations
4. Three-dimensional transformations: translation, rotation, scaling, mirror reflection, order of transformations
5. Projections: orthographic projection, axonometric projection, isometric projection, perspective, viewpoint transformation
6. Visibility: Hidden edges and clipping
7. Curves and curved surfaces: Bezier curves, B spline, NURBS, Bezier surfaces, B spline surfaces
8. Illumination and reflection: light sources, ambient light, diffuse reflection, specular reflection, atmospheric attenuation, shadows
9. Shading: flat, Gouraud, Phong
10. Animation in computer graphics

practical teaching

During exercises student masters practical application of knowledge gained during lectures. Based on programming skills, student writes subroutines, which represent elementary building blocks of computer graphics. While testing programs, students revel the complexity of application of computer graphics as well as the principles of solving computer graphics problems. Finally, students are presented with commercial products based on computer graphics application and compare their own solutions with commercial.
prerequisite

Programming basics

learning resources

Jakovljevic Zivana, Computer Graphics, lecture handouts
Computer classroom – each student individually works on a computer
Visual Studio 2010
Commercial CAD software

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 28
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 1
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 8
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 30
laboratory exercises: 25
calculation tasks: 10
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
COMPUTER GRAPHICS

ID: BSc-0433
teaching professor: Бојанић О. Павао
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: production engineering

goals

1. An understanding of the role and importance of computer graphics in engineering activities
2. Mastery of theoretical and mathematical basics of computer graphics
3. Acquisition of practical knowledge about computer graphics application
4. Use of knowledge in the development of engineering applications based on computer-graphics.

learning outcomes

1. Fundamental knowledge of computer graphics
2. Fundamental knowledge relevant to the methods based on computer graphics application
3. Skill to apply principles of computer graphics to the development of engineering software applications
4. Gaining of practical experience in the development of software solutions based on computer graphics application

theoretical teaching


practical teaching

Within the framework of practical teaching, the student is practicing what he has learned during theoretical teaching hours. Relying on the knowledge of computer programming, he writes programs by himself, which are the constituents of computer graphics. By testing the programs the student becomes familiar with the complexity of computer graphics problems as well as with the principles for solving them. Lastly, the student is introduced with commercial products generated by computer graphics application and compares his solutions with those commercial. All theoretical knowledge acquired during theoretical teaching, which is a basis for developing contemporary CAD systems, should enable student to fully understand this area of computer application, to participate in the design and development of such systems.

prerequisite

There are no prerequisites, because the Course is elective.
learning resources

Practical teaching proceeds in the computer room. Each student works independently supervised by the teaching assistant or instructor. Previously studied programming languages and any commercial CAD system will be installed in the computers, so that students can compare their solutions with those commercial.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 1
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 9
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40

requirements to take the exam (number of points): 40

references
Computer simulation and artificial intelligence

ID: BSc-0404

teaching professor: Бабић Р. Бојан

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: production engineering

goals

The aim of the course is to develop student's ability to model and analyze real system using discrete event simulation along with application of models, analysis of simulation results and comparison of alternative solutions. Artificial intelligence will be understood through models, structure of intelligent agents and machine learning. By using of simulation and software tools students will get knowledge for application of artificial neural networks.

learning outcomes

After the course the students will understand the power, characteristics and limitations of discrete event simulation and how it is applicable for analyses and development of manufacturing and other discrete systems. Students' abilities to implement the model in a computer system will be developed. Also students will be able to verify the model built, to evaluate and analyze the model output, to compare alternatives and to make appropriate suggestions for the real system. Students will be able to independently choose methods based on application of artificial neural networks for solving of engineering problems along with modelling of optimal structure. They will also have ability to use software for simulation of artificial neural networks, analysis and presentation of obtained results.

theoretical teaching

Introduction to discrete event simulation. What is simulation, when it is applicable to use simulation, classification of models, types of simulation, steps in simulation, study, advantages/disadvantages of simulation study. Concept of discrete event simulation, list processing. Simulation package AnyLogic. Application of simulation. Verification and evaluation of simulation models, analysis of output data, comparison of alternative designs of systems. Simulation of manufacturing systems. Artificial intelligence - definitions, basic concepts and paradigms. Knowledge bases, knowledge acquisition, models of learning, searching tree, development of soft-computing, autonomous systems. Structure of artificial neural network (ANN), neuron - processing element, transfer (activation) function. ANN models, learning algorithms, uncertainty of system, non-linearity, estimation, clustering. Application of ANN.

practical teaching

prerequisite

Defined by curriculum of study programme/module.

learning resources

(1) B. Babic, FLEXY–INTELLIGENT EXPERT SYSTEM FOR FMS DESIGN, Intelligent Manufacturing Systems Series, Book 5, University of Belgrade, Faculty of Mechanical Engineering, 1994, 18.1
(2) Z. Miljković, SYSTEMS OF ARTIFICIAL NEURAL NETWORKS IN PRODUCTION TECHNOLOGIES, Series IMS, Vol. 8, University of Belgrade, Faculty of Mechanical Engineering, 2003, 18.1 /In Serbian/
(3) Z. Miljković, D. Aleksendrić, ARTIFICIAL NEURAL NETWORKS – solved examples with short theory background, Textbook, University of Belgrade, Faculty of Mechanical Engineering, 2009, 18.1 /In Serbian/
(4) B. Babic, Z. Miljković, Handouts, University of Belgrade, Faculty of Mechanical Engineering, 2011, 18.13 /In Serbian/
(5) B. Babic, Z. Miljković, Software "Moodle" for distance learning (http://147.91.26.15/moodle/), University of Belgrade, Faculty of Mechanical Engineering, 2011, 18.13
(6) B. Babic, Z. Miljković, Website for Computer simulation and artificial intelligence (http://cent.mas.bg.ac.rs/nastava/ksivi_mo/KSiVI_2009-2010.html), University of Belgrade, Faculty of Mechanical Engineering, 2011, 18.13
(7) AnyLogic simulation software
(8) Z. Miljković, Software packages for simulation of artificial neural networks - BPnet, ART Simulator; Laboratory CeNT website: http://cent.mas.bg.ac.rs/nastava/ksivi_mo/KSiVI_2009-2010.html, University of Belgrade, Faculty of Mechanical Engineering, 18.13

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 22
calculation tasks: 0
seminar works: 8
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 6
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 4
final exam: 5
assessment of knowledge (maximum number of points - 100)

feedback during course study: 15
test/colloquium: 20
laboratory exercises: 0
calculation tasks: 0
seminar works: 35
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references

Cybernetics

ID: BSc-0061
teaching professor: Петровић Б. Петар
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: production engineering

goals

1. Understanding cybernetic concept of system and its implications to mechanical engineering.
2. Fundamental knowledge on general systems theory, modeling and simulation.
3. Basic knowledge on abstract information machines.
4. Digital computer organization and architecture.
5. Complexity and basic concepts of self-organization, machine learning and artificial intelligence.

learning outcomes

1. Skill to apply systemic approach in engineering problem-solving;
2. Fundamental knowledge of the principles of digital information machines operating principles;
3. Fundamental knowledge on machine learning, self-organization and artificial intelligence;
4. Practical skills hardware organization and programming of microcontrollers.

theoretical teaching

Four teaching units:
1. Cybernetic concept of general controlled and control systems – classification and modeling, general aspects of dynamical system, state space; controllability, observability, stability, system composition and decomposition, linear dynamic systems;
2. Abstract Information machines - theory of automata (FSM modeling and synthesis, tape automata, Turing machine), formal grammars and artificial languages;
3. Digital computer - binary logic and arithmetics, basic combinational and sequential circuits, microprocessor, interfaces and networking;

practical teaching

Practical teaching includes laboratory exercises and project.
Laboratory exercises:
1. Modeling and simulation of dynamic systems;
2. Man-machine interface;
3. Pattern recognition and artificial intelligence.
The project is focused to the domain of practical implementation of theoretical contents presented through four teaching units. It is to be accomplished by using microcontrollers as a minimal computer platform enabling students to gain practical knowledge and skills in the area of modern digital computer technology.

prerequisite

Basic knowledge of Kinematics, Dynamics, Computation, Numerical methods and Mathematics
**learning resources**

[1] P.B. Petrovic, Cybernetics, Faculty of Mechanical Engineering /In Serbian/,  
[2] Lectures in e-form /In Serbian/,  
[3] Instructions for writing laboratory reports/In Serbian/,  
[4] Instructions and a referent example of the project /In Serbian/,  
[5] Instructions for safe handling of laboratory equipment /In Serbian/.  
[6] MatLab simulation system practical training in dynamic systems simulation and analysis,  
[7] Development system based on Microchip PIC16 and PIC18 RISC microcontrollers for practical understanding digital computer organization and machine language,  
[8] Compilers and High-level language development systems for Microchip PIC16 and PIC18 RISC microcontrollers (MicroC, MicroPascal),  
[9] Peripheral modules for Microchip PIC16 and PIC18 RISC microcontrollers ofr practical trainings with digital and analogue signals, interfacing and networking and building human-machine interfaces,  
[10] Robot arm, mobile robot and digital camera for students training in practical use of microcontrollers.

**number of hours**

Total number of hours: 75

**active teaching (theoretical)**

Lectures: 30

**active teaching (practical)**

Auditory exercises: 6  
Laboratory exercises: 6  
Calculation tasks: 0  
Seminar works: 0  
Project design: 16  
Consultations: 2  
Discussion and workshop: 0  
Research: 0

**knowledge checks**

Check and assessment of calculation tasks: 0  
Check and assessment of lab reports: 2  
Check and assessment of seminar works: 0  
Check and assessment of projects: 2  
Colloquium, with assessment: 0  
Test, with assessment: 6  
Final exam: 5

**assessment of knowledge (maximum number of points - 100)**

Feedback during course study: 10  
Test/colloquium: 25  
Laboratory exercises: 10  
Calculation tasks: 0  
Seminar works: 0
project design: 15
final exam: 40
requirements to take the exam (number of points): 30

references

Machine tools

ID: BSc-0043

teaching professor: Главоњић М. Милош

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: oral

parent department: production engineering

goals

2. Acquisition of basic knowledge about machine tool primary motion configuration for cutting and deformation processing and configuration of feed motions.
3. Studies of machine tool structures, guides foundations and machine tools testing.
4. Studying and practicing the control and programming of numerically controlled machine tools and making a report on acquired knowledge.

learning outcomes

1. Ability to manage in the machine tools environment and preparing them for work.
2. Know-how to configure primary and feed motions of machine tools.
3. Ability to design and perform the experiment to test a machine tool and to identify the machining process.
4. Know-how to program numerically controlled machine tools.

theoretical teaching

New teaching contents:
Learning resources.
2. The machine tools saga.
3. Work diagram of the primary motion of cutting machines and electromechanical drives for primary rotary motion.
5. Work diagram of feed motions in metal cutting machines.
7. Electromechanical feed drives.
8. Machine tools testing.
Elaboration of new teaching contents and instructions for doing the tasks:
1. Work diagram of the primary motion.
2. Dimensioning of press energy accumulators.
3. Work diagram of feed motions.
4. Identification of machine tools guides.
5. Configuring of electromechanical feed drives.

practical teaching

Practical teaching consists of auditorial exercises, laboratory work, home work, seminar work and consultations. It embraces the following units:
1. One auditorial exercise: Resources for studying machine tools.
2. Four laboratory exercises: (1) Handling and manual operating of machine tools and handling...
of measuring equipment in the Laboratory for machine tools. (2) Identification of the main factors in deformation processing. (3) Machine tools testing. (4) Control and programming of machine tools. Instructions for work are given for each exercise, while forms and reports making are prepared beforehand.

3. Five home works
4. One seminar work is done about control and programming of machine tools.
5. One consultation.

A report on acquired knowledge of machine tools is prepared in parallel. Knowledge check comprises: two tests, three colloquiums and final examination.

prerequisite

Study curriculum and student motivation for learning about machine tools and machining systems according to the goals set and outcomes offered.

learning resources

5. LPI-1: Three work places with manually controlled machine tools.
6. LPI-2: Three work places with numerically controlled machine tools.
7. LMS-2: One work place for identifying principle factors in processing deformation. 8. LPS-1: Functional simulators of parallel machines kinematics.
10. ARS-1: System for experimental data acquisition and analysis.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 2
laboratory exercises: 25
calculation tasks: 0
seminar works: 2
project design: 0
consultations: 1
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 5
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 3
test, with assessment: 2
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 10
seminar works: 10
project design: 10
final exam: 30
requirements to take the exam (number of points): 30

references

N.N, Visionary Manufacturing Challenges for 2020, National Academy Press, Washington, D.C.
Suk-Hwan Suh, Seong-Kyoon Kang, Dae-Hyuk Chung, Ian Stroud, Theory and Design of CNC
L.N. López de Lacalle, A. Lamikiz, Editors, Machine Tools for High Performance Machining,
M. Weck, C. Brecher, Werkzeugmaschinen 2, Konstruktion und Berechnung, Springer 2006,
9780872634923.
Manufacturing Technology

ID: BSc-0065

teaching professor: Тановић М. Љубодраг

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: oral

parent department: production engineering

goals

Manufacturing technology is a science and engineering practice in mechanical engineering and industrial environment to obtain a finished product. The aim of the course is to develop creative skills, in students of all modules, for product design, design for manufacturing and maintenance of industrial equipment in industrial production.

learning outcomes

The student should acquire knowledge and develop skills needed for advanced critical and self-critical approach to technology design, manufacturing of finished parts and equipment and overhauling, manufacturing methods, solving of concrete problems by using scientific methods and procedures.

theoretical teaching


practical teaching

PA-1: Historical overview of the manufacturing process; PA-2; PA-3; AR-1; PA-4; AP-2; AR-3; PZ-1: A task in machining process; PZ-2: A task in forging; PZ-3: A task in drawing; PL-1: Metalworking machine tools for chip removal (milling machine, Pfauter milling machine, Fellows planer, grinding machine for flat surface and round grinding); PL-2: Metalworking machine tools for chip removal (lathe, planer and radial drill); PL-3: Metalworking machine tools for deformation processes + Finite-element method using the example of MEKELBA package and simulation of metal forming processes – OSA; PL-4: Technology design for CNC machine tools and industrial robots application.

prerequisite

Defined by the Study Program Curriculum.

learning resources

1. Laboratory machines: lathe, planer, radial drill, milling machine, Pfauter milling machine, grinding machine, machining centers, presses, robots, laboratory for FTS, machining processes and tools, ЛПИ.
**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 5  
laboratory exercises: 12  
calculation tasks: 13  
seminar works: 0  
project design: 0  
consultations: 0  
discussion and workshop: 0  
research: 0

**knowledge checks**

check and assessment of calculation tasks: 2  
check and assessment of lab reports: 4  
check and assessment of seminar works: 0  
check and assessment of projects: 0  
colloquium, with assessment: 0  
test, with assessment: 4  
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10  
test/colloquium: 20  
laboratory exercises: 20  
calculation tasks: 20  
seminar works: 0  
project design: 0  
final exam: 30  
requirements to take the exam (number of points): 30

**references**

Kalajdžić, M. Manufacturing technology, FME, Belgrade, 2006, КДА /In Serbian/  
Tanovic Lj., Petrakov J., Theory and simulation of machining processes, FME, Belgrade, 2007 /In Serbian/
Production technology and metrology

ID: BSc-0066

**teaching professor:** Мајсторовић Д. Видосав

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** production engineering

**goals**

The aims of the course are to acquaint students with theoretical and applied knowledge and regularities in the treatment processes and metrological systems in production engineering, using systemic approach. This knowledge helps production engineers to manage treatment and metrological processes in the quality management system.

**learning outcomes**

The student should acquire theoretical and practical knowledge for production technologies and metrology to be able to independently solve engineering problems in the respective field. This is the reason why the course focuses on acquisition and application of fundamental engineering knowledge of production technologies and metrology.

**theoretical teaching**

AN-1: Basic concepts in the theory of metalworking by plastic deformation;
AN-2: Mechanics of orthogonal cutting;
AN-3: Thermodynamics of cutting process and application of coolants and lubricants; AN-4: Tribology of cutting process;
AN-5: Material machinability and techno-economy;
AN-6: Essential characteristics of measuring systems in production metrology;
AN-7: Sensors;
AN-8: Measuring systems in production metrology (1);
AN-9: Measuring systems in production metrology (2);
AN-10: Measuring systems in production metrology (3); Each theoretical teaching hour is followed by one hour of explanations relevant to teaching contents.

**practical teaching**

PR-1: Introductory considerations of production technologies;
PL-1: Determination of deformation in treatment by compression;
PL-2: Resistance measurement in treatment by boring/cutting force;
PL-3: Resistance measurement in treatment by chipping;
PL-4: Methods of cutting temperature measurement;
PL-5: Determination of machinability parameters;
PR-2: Introduction to production metrology;
PL-6: Practical application of metrological systems for length and angle tolerances;
PL-7: Practical application of metrological systems for shape and position tolerances;
PL-8: Practical application of metrological systems for tolerances of micro and macro geometry in treated surface;
PL-9: Legal metrology, standards of length and angle;
PL-10: Industrial metrology/work on NUMM.

**prerequisite**
Defined by the Study Program Curriculum

**learning resources**

[1] Handouts in e-form. /In Serbian/
[2] Instructions for doing laboratory exercises, e-form. /In Serbian/
[4] Site for 1 and 2 contains a list of references in the respective area and links to leading organizations and institutions in this field.
[5] Technical resources for the course: Laboratory for Production metrology and TQM as well as ZMA that have necessary equipment and licensed software for doing exercises in this subject.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 5
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 40
laboratory exercises: 15
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 36

**references**
Handouts in e-form /In Serbian/
Instructions for doing laboratory exercises, e-form /In Serbian/
Textbook of production metrology /In Serbian. In preparation/
Сајт предмета поред 1 и 2 садржи и библиографију рефер. књига и часописа из ове области и линкове са адресама водећих организација и важних институција у овој области.
Technical resources for the course: Laboratory for Production metrology and TQM as well as MTL that have necessary equipment and licensed software for doing exercises in this subject.
Quality of Engineering Education

**ID:** BSc-0060

**teaching professor:** Спасић А. Жарко

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** production engineering

**goals**


**learning outcomes**

Understand the reform of universities in the Bologna principles. Understand the integrated system of quality of the university and suggests improvements. Adopting new teaching methods. Participate in university governance. Developing cognitive characteristics of creative engineers. Participate in project teams. Understand the pedagogical work in secondary and high schools. Criticize the activities and relationships between university and industry.

**theoretical teaching**


**practical teaching**


**prerequisite**

Defined in the curriculum of study program / module.

**learning resources**

Spasić, Ž. et al., Faculty of Mechanical Engineering, University of Belgrade - The mission of the path to European integration, MF, 2003.
Faculty of Mechanical Engineering: Alumni Fund of Faculty of Mechanical Engineering - αMEβ, Editors Ž. Spasić et al. The first Alumni Congress, 2005.

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 8
calculation tasks: 4
seminar works: 6
project design: 10
consultations: 2
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 1
check and assessment of lab reports: 1
check and assessment of seminar works: 2
check and assessment of projects: 2
colloquium, with assessment: 2
test, with assessment: 2
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 5
test/colloquium: 15
laboratory exercises: 10
calculation tasks: 10
seminar works: 10
project design: 10
final exam: 40
requirements to take the exam (number of points): 36

**references**
Shipbuilding Technology

**ID:** BSc-0056  
**teaching professor:** Тановић М. Љубодраг  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** oral  
**parent department:** production engineering

**goals**

To acquire theoretical and practical knowledge of shipbuilding technology, starting from the concept acquisition, calculations and testing, working out of building technology, protection and testing of the ship. To perceive the importance of team-work and cooperation based on arriving at optimal solution.

**learning outcomes**

Fundamental knowledge of machining systems. Ability to design technology of ship structural members. Ability to apply the concepts of modular design and assembly technology. Basic practical experience in realizing the shipbuilding technology.

**theoretical teaching**


**practical teaching**

During laboratory exercises the student is introduced with plate shaping tools. Students pay a visit to a shipyard where they are familiarized with the shipbuilding process: basics of technical standardization, accuracy and quality of ship structural members, tracing, construction of the hull structural members, assembly and welding of the hull units and sections, ship's hull assembly on a shipway, ship launching. Equipment works on the hull, building and assembly of ship systems, assembly works and preparations for assembly.

**prerequisite**

Defined by the Study Program Curriculum.

**learning resources**

3. Laboratory equipment - machines for building ship structural members, Shipyard Belgrade, LPI

**number of hours**

total number of hours: 75
lectures: 30

**active teaching (practical)**

auditory exercises: 6
laboratory exercises: 24
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 10
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 40
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 20

**references**

M. Susa: Shipbuilding technology, FME, Belgrade, 2007 /In Serbian/
Lj. Tanovic: Theory and simulation of the machining process, FME, Belgrade, 2007, KPN /In Serbian/
M.F.Hocker, A.C. Ward: The Philosophy of Shipbuilding, Texas University Press, 2004, USA
SKILL PRAXIS B – ПРО

ID: BSc-0576
teaching professor: Бојовић А. Божица
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 1
final exam: seminar works
parent department: production engineering

goals

The aims are to acquaint students with the environment where production, technological and metalworking processes take place. Students of production engineering will acquire knowledge in the domain of production systems (machine systems, industrial robots, tools and tooling and measuring equipment), production and information technologies, storage of equipment, primary materials, organizational structure of some producing enterprises (visit to enterprises). Students gain experience in the domain of manufacturing technologies, machine tools, industrial robots, manufacturing automation, and use of computers in design, production and information-communication technologies.

learning outcomes

Having successfully completed Skill Praxis, the student should gain practical knowledge of production technologies, machine tools, industrial robots, manufacturing automation, computer use in machine design, manufacturing and information-communication technologies.

theoretical teaching

practical teaching

Role and importance of skill praxis. (What a production engineer should know.). Lathe and bore machining. Practical realization of lathe and bore machining; Milling and grinding machining. Practical realization of milling and grinding machining; Press machining. Practical realization of press machining; Getting acquainted with work space and rules related to work place and use of laboratory.; Programs of engineering measurement and measuring techniques. Measurement of length, angles, roughness, and getting familiar with standards for machining quality notation; Robotics and automation in manufacturing. Practical realization of the application of robotics and manufacturing automation systems; Design of technological process and drawing up of technical-technological documentation. Getting familiar with the contents of technical-technological documentation; Enterprise spatial plan, function of enterprise development, and supervision of storage and warehouse. A visit to a producing enterprise, so that students are acquainted with spatial plan, development function and warehouse operating process. Screening of production plant, material flow and machine layout; A visit to a producing enterprise, so that students get acquainted with machine layout in its plants and material transport flow; Assembly technology and system of quality. Getting acquainted with assembly procedures in complex products and quality control systems; Organizational scheme of enterprise with its plants and enterprise information system. Getting acquainted with functions of producing enterprise and developed information systems.

prerequisite

Defined by the Study Program Curriculum

learning resources

**number of hours**

total number of hours: 46

**active teaching (theoretical)**

lectures: 0

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 41
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 70
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 0

**references**

"Алати и прибори", Љ. Тановић, М. Јовичић, Машински факултет, Београд, 2005.
TOOLS AND FIXTURES

ID: BSc-0032

teaching professor: Тановић М. Љубодраг

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: oral

parent department: production engineering

goals

Acquisition of theoretical and practical knowledge of design, computations and constructions of clamping fixtures, sheet-metal processing tools, metal pressure casting tools, forming and shaping plastics tools and forging tools, all this based on modern technologies and optimal solution.

learning outcomes

1. Fundamental knowledge of tools and fixtures as a sub-system of the processing system. 2. Know-how to approach to the design process. 3. Thorough knowledge and understanding of the design process of processing technology and shaping. 4. Basic practical experience acquisition in industrial production of tools and fixtures.

theoretical teaching


practical teaching

Laboratory exercises where students accomplish practically the task of cutting tools and fixtures conception. Of the cutting tools, students are acquainted with the design of turning tool, drill, counter-bore, reamer, tap, milling cutter, wheel, as well as with engineering materials used to make cutting tools. Of the clamping fixtures, students are familiarized with three-jaw chuck, rotating center, rest, lathe dog, wedge-lock vise, expansion collets, as well as with the design of universal, special and universal jig and fixture system. Design project for a concrete task related to engineering practice.

prerequisite

Defined by the Study Program Curriculum.

learning resources

1. Universal fixtures, Special clamping fixtures and Aggregated clamping fixtures, Lab for FTS, metal working and tools, ЛПС [In Serbian]
2. Cutting tools, sheet-metal processing tools and forging tools, Lab for FTS, metal working and tools, ЛПС [In Serbian]

number of hours

423
total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 14
calculation tasks: 0
seminar works: 0
project design: 14
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 6
colloquium, with assessment: 0
test, with assessment: 4
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 10
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 40
requirements to take the exam (number of points): 40

references

Tanović Lj., Jovičić M., TOOLS AND FIXTURES – design, computations and constructions of clamping fixtures, FME, Belgrade, 2011, КПН [In Serbian]
Jovičić M, Tanović Lj., TOOLS AND FIXTURES – computations and construction of tools for building a sheet metal part, FME, Belgrade, 2007, КПН [In Serbian]
railway mechanical engineering

Elective skill praxis B / ŽEM
Fundamentals of Rail Vehicles
Life cycle of Railway Vehicles
Theory of Traction
Elective skill praxis B / ŽEM

**ID:** BSc-0395  
**teaching professor:** Симић Ж. Горан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 1  
**final exam:** oral  
**parent department:** railway mechanical engineering

**goals**

1. Understanding the fundamentals of design of powered and non-powered rail vehicles  
2. Acquire practical insight into the fundamental problems of service management of the rolling stock  
3. Acquire practical insight into the basics of organization of the maintenance of rail rolling stock  
4. Understanding the fundamentals of the production techniques and production processes that are used for rail vehicles

**learning outcomes**

After the end of the course the student should be able to:  
1. Recognize typical vehicles and their main assemblies of the vehicles existing on the practicing site.  
2. Explain the main tasks of the plant where he/she was practicing.  
3. Identify the main manufacturing or maintenance techniques and processes used at the practicing site.

**theoretical teaching**

Instructions for the practice that are defined individually for each student depending on the organization where practice will be done.  
Basic safety measures while being on the practice.  
Instructions for keeping a diary or writing praxis reports.

**practical teaching**

The practice, as a rule, is carried out as several days staying in rail vehicle manufacturing, operating or maintaining plants organised by Railway Mechanical Engineering Department. Alternatively, the practice can be done through several one-day visits to various plants related to the rail industry. During the practice students familiarise with activities, management, techniques and technologies used at the practice site. On this basis, each student fills "Practice Diary" which should show the fundamental elements of management, technology or manufacturing processes or the processes and techniques of maintenance of rail vehicles he/she met in practice. Upon completion of the practice, students pass the "Diary of practice" to the teacher. Oral presentation and discussion will be organised for the group of students.

**prerequisite**

**learning resources**

Lučanin V., Theory of traction, Faculty of Mechanical Engineering Belgrade 1996.  
G. Simić, Fundamentals of rail vehicles, hand-out
G. Simic, Instructions for writing student papers, hand-out
Documents obtained at the practice plant.

**number of hours**

total number of hours: 46

**active teaching (theoretical)**

lectures: 0

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 20
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 30
project design: 0
final exam: 50
requirements to take the exam (number of points): 0

**references**
Fundamentals of Rail Vehicles

**ID:** BSc-0227  
**teaching professor:** Симић Ж. Горан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** oral  
**parent department:** railway mechanical engineering

**goals**

1. Understanding the basic rail vehicles assembling units  
2. Acquiring the knowledge necessary to understand functioning of the basic structural units  
3. Training for the application of acquired knowledge to solve practical problems, especially in the field of the maintenance of railway vehicles.

**learning outcomes**

At the end of the course the student should be able to:

1. Explain the functional and structural differences between basic types of rolling stock.  
2. Explain the tasks and functioning of the main assemblies of rail vehicles.  
3. Identify actions required to resolve typical failures in operation and in the maintenance of the rail vehicles.  
4. Apply appropriate regulations and standards in the design and maintenance of railway vehicles.  
5. Apply basic computer tools to construct and calculate simple assemblies of rail vehicles.

**theoretical teaching**


**practical teaching**

Summary of structural variants of different types of rail vehicles. Examples of selection and limitations of basic parameters. Signage of rail vehicles. The examples and analysis of the regulation excerpts. Load analysis of the wheelsets. Inspection of the wheelsets. Load analysis of the bogie frame. Load analysis of the carbody. Examples of strength calculations. Design variants of the elastic suspension systems. The fundamental parameters of the elastic suspension system and boundary conditions for their selection and calculation. Types of draw-buff gear. Main characteristics of draw-buff gear and their testing. Review of the brake system on the train and on the individual vehicle. Inspection of the basic parameters of the new brakes, after repair and in daily operation.

**prerequisite**

Entered the third year. Desirable: passed courses Mechanics 1, 2 and 3, The base of the strength of constructions and Machine elements 1 and 2.
learning resources

G. Simic, Fundamentals of rail vehicles, hand-out
G. Simic, Instructions for writing student papers, hand-out

For the tasks realisation shall be used appropriate regulations and standards.

number of hours

total number of hours: 75

active teaching (theoretical)
lectures: 30

active teaching (practical)
auditory exercises: 11
laboratory exercises: 0
calculation tasks: 7
seminar works: 3
project design: 0
consultations: 4
discussion and workshop: 5
research: 0

knowledge checks
check and assessment of calculation tasks: 6
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)
feedback during course study: 0
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 15
seminar works: 5
project design: 0
final exam: 50
requirements to take the exam (number of points): 25

references
Life cycle of Railway Vehicles

ID: BSc-0388

**teaching professor:** Ључанин Ј. Војкан

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** oral

**parent department:** railway mechanical engineering

**goals**

1. Introduction to basic concepts important for understanding the life cycle of railway vehicles
2. Acquiring knowledge necessary to understand the issues of the life cycle of railway vehicles
3. Training for the application of acquired knowledge in solving practical problems in the design, use and maintenance of railway vehicles

**learning outcomes**

Upon completion of the course student should be able to:

1. Explain the basic concepts related to the life cycle of railway vehicles.
2. Explain the tasks and functioning related to railway vehicles components for achieving the set goal.
3. Perform appropriate tasks related to the life cycle of railway vehicles.
4. Apply appropriate regulations and standards.
5. Apply appropriate computational tools and to be able to make appropriate decisions.

**theoretical teaching**

Theoretical classes (Definition of rail vehicles and systems as required, Design and production, Use and maintenance, Concept of system effectiveness, Theoretical basis of reliability, Methods of determining the reliability, Prediction of reliability, Allocation of reliability, Failure analysis, System maintenance, The concept of maintenance, Maintenance technologies, Information systems in maintaining, Phase conception - the mission profile and scenario, Feasibility studies, Operational and maintenance concepts, Factors of effectiveness of work and support, Criteria for protection and logistical planning, Preliminary phase of development, Preparation of detailed project, Prediction and analysis of technical support, Review of construction, Testing and evaluation, Feedback and corrective action, Production, installation, testing, control and distribution devices, Implementation and data collection on elements of technical support, Use and maintain in the exploitation conditions, Testing process, Capability rating of technical support, Feedback and corrective action, Standards of the International Union of Railways, National standards IEC-EN, Regulations of the national railways in the area of operation and maintenance, Workshops for the maintenance of railway vehicles, General settings of maintenance technology, Technology in railway vehicles maintenance.

**practical teaching**

Practical learning, auditory exercises, assignments, presentation of practical examples in the field of designing, production, use and maintenance. Discussion and workshops.

**prerequisite**

Attended and passed the course Mechanics 1.

**learning resources**
Syllabus, Guidebook for solving the tasks, Handouts, Internet resources, articles

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 20

**active teaching (practical)**

auditory exercises: 28
laboratory exercises: 0
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 5
discussion and workshop: 5
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 5
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 25
laboratory exercises: 0
calculation tasks: 20
seminar works: 0
project design: 0
final exam: 45
requirements to take the exam (number of points): 35

**references**
Theory of Traction

ID: BSc-0098
**teaching professor:** Ј. Војкан
**level of studies:** B.Sc. (undergraduate) academic studies
**ECTS credits:** 6
**final exam:** oral
**parent department:** railway mechanical engineering

**goals**

Knowledge acquiring in designing, production and exploitation of railway vehicle, in designing of rail tracks as well as the organization of railway traffic.
Introducing students with:
- The Forces acting on railway vehicle
- Calculation methods for traction, resistance and braking force and the velocity, using modern computer tools.
- The methods for determination of optimal movement conditions of railway vehicles
- Ways of solving practical problems related to the movement of railway vehicles and rail tracks configuration.

**learning outcomes**

Understanding and ability to apply knowledge acquired in:
- Calculation of traction, resistance and braking forces and the velocity, using compatible computer software,
- Defining Task and compositional functionality of railway vehicles,
- Using of adequate regulations and standards in the field of traction at railway vehicles.

**theoretical teaching**

Characteristics of the railway transport, Analysis of the influencing factors on the traction forces, Transmission of traction forces – adhesion as requirement for traction forces, Traction features of high-speed railway vehicles, Traction features of the diesel traction railway vehicles, Basic characteristics of running gear and drive of traction vehicle, Traction features of the electric traction railway vehicles, Train resistance – main and additional resistance, High speeds train resistance, Railway vehicles braking force – characteristics of the braking process, Equations of the train.

**practical teaching**

Practical learning, Auditory exercises (Introduction to the examples in modern railway transport, Recapitulation of learned material necessary for passing this subject (mechanics, machine elements and electrical engineering), Using of computer tools to solve problems in train traction, Guidance of wheel set in track, The relative velocity of wheel set in relation to the rail, Forces at the wheel set edge point and the contact point of the wheel-rail, Basic characteristics of traction features, adhesion as requirements for traction forces, Basic characteristics of diesel and electric traction railway vehicles, The resistance forces in motion the train, Task (Determination of traction characteristics of the diesel traction vehicles with mechanical and hydraulic power transmission, Determination of traction characteristics of the diesel traction vehicles with electric power transmission, Determination of traction characteristics of the electric traction vehicle, Analytical determination of the resistance force when moving train, Solving differential equations of train), Discussions and workshops.

**prerequisite**
Attended and passed the course Mechanics 1.

learning resources

Literature that is available in the Faculty Bookstore and Library; Handouts available on lectures; Internet resources (KOBSON).

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 9
laboratory exercises: 0
calculation tasks: 11
seminar works: 0
project design: 0
consultations: 5
discussion and workshop: 5
research: 0

knowledge checks

check and assessment of calculation tasks: 5
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 20
seminar works: 5
project design: 0
final exam: 35
requirements to take the exam (number of points): 35

references

Lucanin, V., Theory of Traction, Faculty of Mechanical Engineering, Belgrade, 1996.
ID: BSc-0652

**teaching professor:** Ључанин Ј. Војкан

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** oral

**parent department:** railway mechanical engineering

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### goals

### learning outcomes

### theoretical teaching

### practical teaching

### prerequisite

### learning resources

### number of hours

**total number of hours:** 75

### active teaching (theoretical)

- lectures: 30

### active teaching (practical)

- auditory exercises: 20
- laboratory exercises: 0
- calculation tasks: 0
- seminar works: 0
- project design: 0
- consultations: 5
- discussion and workshop: 10
- research: 0

### knowledge checks

- check and assessment of calculation tasks: 0
- check and assessment of lab reports: 0
- check and assessment of seminar works: 0
- check and assessment of projects: 0
- colloquium, with assessment: 6
- test, with assessment: 0
- final exam: 4

### assessment of knowledge (maximum number of points - 100)

- feedback during course study: 20
- test/colloquium: 30
- laboratory exercises: 0
- calculation tasks: 0
- seminar works: 0
- project design: 0
final exam: 50
requirements to take the exam (number of points): 0

references
strength of structures

Strength of materials
The Base of the Strength of Constructions
Strength of materials

ID: BSc-0020
teaching professor: Милованчевић Ђ. Милорад
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 4
final exam: written+oral
parent department: strength of structures

goals

The aim of this course is to introduce students to the concepts of stress and strain, the relevant material properties and geometric characteristics of the cross sections. The core of this matter relates to the determination of stress and strain of an elementary loading types (axial loading, torsion, bending). The special attention is in the interpretation of the physicality of the problem, too.

learning outcomes

By mastering the curriculum, the students receive the following skills: mastery of methods, procedures and processes of research; in-depth knowledge and understanding the concept of the strength theory; solving practical problems using scientific methods and procedures; linking basic knowledges from various fields with the aim of making it usable in practice and in various computer programs.

theoretical teaching


practical teaching

Practical instruction: tasks relating to the calculation of geometrical characteristics of the cross-sections (moment of inertia); the calculation of stress and strain in primary loading of structural elements: axial loading (the effect of mechanical forces and temperature, normal stress, static notion of uncertainty, the plan shifts), torsion (shear stress, angle of torsion, dimensioning by the allowed stress and allowable angle), pure bending and bending by forces (distribution of normal stresses and shear stresses in the cross section beams, standard sections, deformation of beams with overhangs and joints). Consultation and individual work tasks in these fields.

prerequisite

The condition is defined by the curriculum program of the study.

learning resources
1. Strength of Materials: Milorad Milovančević, Nina Andelić (tutorial);

2. Tables from the strength of materials: D. Ružić, R.Čukić, M. Dunjić, M. Milovančević, N. Andjelic, V. Milosevic Mitic;

3. Handouts from the site of the Department of Strength of constructions;

number of hours

total number of hours: 45

active teaching (theoretical)

lectures: 18

active teaching (practical)

auditory exercises: 14
laboratory exercises: 0
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 15

references
The Base of the Strength of Constructions

ID: BSc-0021

**teaching professor:** Манески Ђ. Ташко  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** strength of structures

**goals**

The aim of this course is to introduce students to some complex loadings. The bending of the statically indeterminate beams, as well as torsion and buckling of an arbitrary cross sections are considering. Course shows the method of determining the equivalent stresses in a complex spatial loading of structures, that students later can use the computer programs based on Finite Element Method-FEM.

**learning outcomes**

Mastering the program contemplated by this course, students acquire next skills: mastering of methods, procedures and processes of research in this field; application the knowledge in this practice; thorough knowledge and understanding of the discipline; solving practical problems using scientific and technical methods and procedures; the possibility of the proper use of computer programs based on Finite Element Method-FEM.

**theoretical teaching**


**practical teaching**

The tasks of buckling. Examples of statically indeterminate beams. Determination of displacements for statically determinated plane beam-constructions on bending load. Application of deformation energy and Castigliano’s theorem. Application of the force method for the solution of statically indeterminate problems (external static indefinite beams, symmetrical and closed structures). Calculation of torsional characteristics of various cross-sections. Application of the hypothesis: general considerations, the maximal normal stress, the maximal shear stress and the maximal specific deformation energy of the shape changes. Complex loads constructions - circular and prismatic cross-section, thin-walled cross-sections, standard sections. Examples of displacement method. Consultations and individual work tasks. Laboratory exercise.

**prerequisite**

The condition is defined by the curriculum program of the study.

**learning resources**
2. Handouts from the site of the Department

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 20
laboratory exercises: 5
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 3
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 5
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 50
laboratory exercises: 5
calculation tasks: 5
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

**references**
theory of mechanisms and machines

Basic Technological Operations in Food Industry
CONSTRUCTIVE GEOMETRY AND GRAPHICS
DESIGN OF MACHINERY
ENGINEERING DRAWING
Engineering Graphics
Food Processing Engineering Practice(B.Sc.)
Hydraulic and Pneumatic Mechanisms and Piping
Mechanism Design
Basic Technological Operations in Food Industry

ID: BSc-0228

**teaching professor:** Стоименов Д. Миодраг

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** theory of mechanisms and machines

**goals**

1. Acquisition of basic knowledge of physical and chemical changes in materials that are processed during the technological process in the food industry.
2. Understanding the basic concepts necessary for rezumevanje matter in the field of food technology.
3. The division of the basic technological operations encountered in the food industry, primarily in the mill and bakery and confectionery, dairy, slaughter-mesarskoj and fruit-vegetable industry

**learning outcomes**

1. Analysis of existing solutions and their effects
2. prektičnih adoption of knowledge
3. application of knowledge in practice
4. knowledge and understanding of issues in the food process industry
5. solving process, examples of food
6. connect knowledge from different fields and their application
7. monitoring and implementation of innovations in the profession.

**theoretical teaching**


**practical teaching**

The first laboratory exercise: going to a facility that deals with the mechanical operations in the manufacture of food products, following mechanical operations, the report. The second
laboratory exercise: go to the plant at which heat is carried out operations in the production of food products, operations monitoring and report writing. The third laboratory exercise: visit facilities that handle food products, and Prečenje transpotra analysis, report writing. Development of the project, which includes defining the terms of reference, the necessary calculations and complete the drafting of the technological process of the finished food products. Consultation: Review completed active teaching and student questions.

**prerequisite**

Collected enough points to enter the sixth semester

**learning resources**

Script in preparation, M. Stoimenov. To cope with cases it is necessary to use the instructions for creating a project, a handout, Internet resources and video

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 19
calculation tasks: 0
seminar works: 0
project design: 9
consultations: 2
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 3
check and assessment of seminar works: 0
check and assessment of projects: 3
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 15
calculation tasks: 0
seminar works: 0
project design: 25
final exam: 30
requirements to take the exam (number of points): 42
references
CONSTRUCTIVE GEOMETRY AND GRAPHICS

ID: BSc-0203

**teaching professor:** Попконстантиновић Д. Бранислав

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 2

**final exam:** written

**parent department:** theory of mechanisms and machines

**goals**

The objectives of this course are to acquire knowledge for comprehending, constructive processing and modeling of the objects of three-dimensional space. Practicing and mastering the basic operations and methods for efficient geometric analysis and synthesis of various abstract and concrete forms can be considered as the study program objective. Moreover, particularly important goal of this course is the theoretical preparation and development of creative skills for effective use of modern software packages for three-dimensional modeling and design.

**learning outcomes**

Mastering the program, students obtain and improve ability to use geometric operations and methods for creative observation and modeling of three-dimensional space. In addition, the adoption of the scheduled curriculum, a student acquires the knowledge and skills for effective visual communication in engineering practice.

**theoretical teaching**

Theoretical course includes:
1) Learning the principles of the Constructive geometry and graphics (CGG), introducing the concepts of projection, orthogonal projections, coordinate systems and spatial coordinates, defining elements, relations, and CGG postulates; explanation of the basic CGG methods;
2) Application of the CGG methods; treatment of classical positional and metric problems;
3) The constructive geometrical analysis and treating of a plane in arbitrary position; the plane revolution, the oblique plane figures;
4) The constructive geometrical analysis and treating of an objects on an incline plane, the spatial positional and metric problems;
5) The polyhedron truncation (truncation of pyramids and prisms), learning the basic principles and constructive geometrical methods of developing surfaces (the net); building the concrete models of truncated prisms and pyramids;

**practical teaching**

Practical lectures are conducted through a cycle of exercise consisting of 6 auditory and 6 independent individual exercises. Auditory exercises students accomplish in college with the help of assistants, and independent practice through homework. The exercises are performed with the following contents:
1. The orthogonal projections delineation, training the use of spatial coordinates, three-dimensional coordinate system and the main issues and postulates of CGG;
2. Practising the basic methods of CGG (transformation and revolution)
3. Application of CGG methods (the measure of lengths, angles, area); practicing the classical positional and metric problems;
4. The constructive geometrical analysis and treating of a plane in arbitrary position, practicing the procedures of geometric plane revolution and modeling of geometrical figures on an oblique plane;
5. Spatial positional and metric problems; constructive analysis and synthesis of geometrical objects on an incline plane;
6. Truncation of pyramids and prisms; practicing the methods and procedures of surface developing (the net) and modeling of a truncated pyramids and prisms;

**prerequisite**

The course of Constructive geometry and graphics is mandatory for all students.

**learning resources**

1. Tutorial: CONSTRUCTIVE GEOMETRY AND GRAPHICS; authors: Dr. Aleksandar Veg, Miodrag Stoimenov, Ljubomir Miladinovic, Branislav Popkonstantinović; Faculty of Mechanical Engineering, Belgrade 2005.
2. Handbook for practice: A constructive geometry in the graphics - PRACTICUM; authors: Dr. Branislav Popkonstantinović, Mr. Zoran ate, Mr. Rasa Andrejevic, Goran Šiniković; Faculty of Mechanical Engineering, Belgrade 2010.

Note: The textbook and handbook are available in printed form.

**number of hours**

total number of hours: 30

**active teaching (theoretical)**

lectures: 12

**active teaching (practical)**

auditory exercises: 6
laboratory exercises: 0
calculation tasks: 6
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 1
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 40
laboratory exercises: 0
calculation tasks: 30
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
DESIGN OF MACHINERY

ID: BSc-0097

Teaching professor: Ђорђевић Р. Стеван

Level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

Final exam: written

Parent department: theory of mechanisms and machines

Goals

Mastering the necessary knowledge and develop creative skills in design and construction of mechanisms machinery and equipment. Mastering some of the software application to design specific mechanisms (machines and devices), and analyze their work to rectify identified deficiencies.

Learning outcomes

Mastering the curriculum, student receives the following specific skills: understanding the issues of the theory of mechanisms and machines; solving concrete problems by using scientific methods and use of adequate software.

Theoretical teaching

Introduction to the Theory of mechanisms, the structure of mechanisms, kinematical member, a kinematical pair, kinematical chain, the number of degrees freedom of movement, basic mechanism, the formation of a complex mechanism, a group of Assur; Grashof conditions, the plane and spatial mechanisms, kinematics of mechanisms, the instant center of rotation, speed of kinematical pairs, the angular velocity kinematical members. Acceleration of kinematical pairs, angular accelerations of kinematical members, dynamics of mechanisms, external and inertial forces and moments in the mechanism, driving force (moment), Theorem of Zukovsky, the forces (pressures) in kinematical pairs; A synthesis of mechanisms, the optimum synthesis of mechanisms in MATLAB; optimal parameter synthesis of mechanisms, functions, objectives, limitations and penalty functions in the objective function; real mechanisms, friction and angles of friction in kinematics pairs.

Practical teaching

The structure of mechanisms, kinematical member, a kinematical pair, kinematical chain, Introduction to work in WORKING MODEL-in, by modeling, modeling of kinematical pair, kinematical chain modeling, selection and setup registration; Setting accuracy mechanism, sensing the position of the kinematical pairs or article; Reading current speed kinematical pairs and angular velocity members, forming a diagram of the cycle rate mechanism; Sensing acceleration and angular kinematical pairs by acceleration, accelerating the formation of a diagram; Entering external
forces and torques in a mechanism, adjusting the way the facility; Introduction and setting the coefficient of friction and the radius of the kinematical pairs, reading forces in kinematical pairs, the formation of force diagram in the series, Introduction to MATLAB, write a portion of the synthesis in MATLAB; Parametric optimal synthesis of mechanisms for a given path (MATLAB) design obtained by synthesis mechanism WORKING MODEL-in.

**Prerequisite**

Class attendance is conditioned by: laid Mechanics 2, desirable laid Mechanics 3

**Learning resources**

A. Sekulic: DESIGNING MECHANISMS;  
B. Gligoric: MECHANISMS;  
S. Djordjevic: Handout;  
WORKING MODEL – Software application  
MATLAB - Software application

**Number of hours**

total number of hours: 75

**Active teaching (theoretical)**

lectures: 30

**Active teaching (practical)**

auditory exercises: 0  
laboratory exercises: 16  
calculation tasks: 0  
seminar works: 0  
project design: 14  
consultations: 0  
discussion and workshop: 0  
research: 0

**Knowledge checks**

check and assessment of calculation tasks: 0  
check and assessment of lab reports: 0  
check and assessment of seminar works: 0  
check and assessment of projects: 0  
colloquium, with assessment: 10  
test, with assessment: 0  
final exam: 5

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

feedback during course study: 0  
test/colloquium: 35  
laboratory exercises: 0  
calculation tasks: 0  
seminar works: 0
project design: 35
final exam: 30
requirements to take the exam (number of points): 25

references

Z. Zivkovic: Mechanisms and Machine Theory;
ENGINEERING DRAWING

ID: BSc-0205

teaching professor: Ђорђевић Р. Стеван

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: theory of machanisms and machines

goals

The main goal of the course is that students master the skills necessary for successful presentation (and reading) technical drawings of machine parts and assemblies. Student should learn and become able to use correctly all standards and other normative rules for 3D solid modeling, assembling and drafting.

learning outcomes

Outcome of the course is the students’ ability for 3D machine parts modeling and assembling by the using of Solid-Works software application. Moreover, students have to develop the abilities for computer aided drafting of machine parts by the using of cross-section methods, dimensioning and surface quality specification in such a way that detail drawings fully define parts for production.

theoretical teaching

Engineering drawing; Representation of three-dimensional objects in two dimensions; Graphical projection; Parts composition; Part view; Standard views; Projected view; Auxiliary view; Section view; Broken-out view; Standard engineering drawing line types and styles; Method of cross-sections; Full section; Half section; Revolved section; Aligned section; Offset section; Broken-out section; Constructive solid geometry; Solid intersections; Simplified presentation of intersection; Symmetrical parts; Repeating details and their presentation; Dimensioning; Function of dimensioning; Elements of dimensioning; Showing dimensions; Methods of dimensioning; Modeling and drafting of threads (helical ridge); Helix; Screw joint; Screw – Nut; Simplified presentation of threads; Thread standards; Surface quality specification; Surface roughness; Surface finish parameters; Drafting specifications; Technical elements of drawings; Technical lettering; Scales; Size of drawing; Standard and general tables, Bill of materials; Revision tables; elements and parts positions; Gears; Springs; Welding joints; Presentations of gears and springs; Presentation and dimensioning of welding butt joints; Tolerances of shape and position; Typical and distinguishing examples of machine parts shape and positions tolerances presentation; Axonometric projections; Axonometric projections of objects and its meaning; Trimetric projection; Dimetric and Isometric projections;

practical teaching

Introduction to Computer Aided Design and Drafting; Introducing the Solid-Works software application; 3D modeling of a simple mechanical part; Drafting of a simple mechanical part in three standard views; “Hidden line visible” method; 3D solid modeling of a mechanical parts and their drafting in three standard views by the using of “Hidden line visible” method; Method of cross-sections; 3D solid modeling of a mechanical parts and their drafting in three standard views by the using of “cross-section” method; Drafting – dimensioning; 3D solid modeling of machine part; Computer Aided Drafting of a technical drawing in standard views by the using of “hidden line visible”; using of auxiliary views and cross-sections; Part dimensioning; Assembly and detail drawings; 3D solid modeling of all parts of machine press (or clamp) assembly; 3D assembling; Computer aided assembly drafting in all necessary views; Assembly
dimensioning; Completing the bill of materials and all standard tables; Computer aided drafting of three detail part drawings; Detail drawing enumeration; Computer Aided Drafting of a complete detail drawing – Adding annotations of surface finish parameters and surface roughness; 3D solid modeling of three complicated machine parts; Computer aided drafting by the using of cross-section method; Using of auxiliary views and cross sections; Dimensioning; Adding annotations of surface finish parameters and surface roughness;

**prerequisite**

Class attendance is not conditioned. Desirable laid Constructive geometry.

**learning resources**

S. Djordjevic: Engineering Graphics, S. Djordjevic, D. Petrovic: ENGINEERING GRAPHICS - Practicum for exercise-

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 0
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 40
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30
references
Engineering Graphics

ID: BSc-0572
teaching professor: Петровић В. Драган
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written
parent department: theory of mechanisms and machines

goals

The goal of the course is that students master the skills necessary for successful viewing (and reading) of machine parts components technical drawings. The student should know all the rules and standards that are used for formating, dimensioning and defining of the machine parts machining on the drawings.

learning outcomes

The outcome of this course is the students' ability to model mechanical parts as well as their assemblies by the using of the software package SolidWorks. Moreover, it is necessary to show the assemblies and parts on drawings with the appropriate sections so that they can be fully formally, dimension and machining defined.

theoretical teaching

Drawing in Mechanical Engineering; displaying objects in the drawing; composition parts, pictures of objects. Axonometric projection of objects and their interpretation. Views; basic views; separate views; types of lines in mechanical engineering. Sections, a complete cross-section; half cross-section, partial cross-section, labeling section; profile sections. Breakthroughs; symmetrical parts, repeated details. Dimensioning; function wheel; elements of Dimensioning; marking point on the drawing; methods quotation. Threads display; coil; threaded double and tags for loops. Marking sheet surface; surface roughness; means for quality of workmanship, labeling on the drawings. Technical Letter; scale, the formats, headers and components; positional label elements. Gear display; Springs display; Welded seams display. Shape and position tolerances.

practical teaching

Introduction to SolidWorks software package; Making 3D model of simple machine part, display the same model in three main respects. Production 3D model of machine parts and its clarity of the presentation by the three main views. Production 3D model of machine part and its representation by imaginary sections in three major respects. Preparation 3D model of a given machine part; making technical drawings in sufficient numbers of views using the imaginary section; the using of special views and sections; dimensioning part of the drawing. Molding all parts of the assembly Press device(Clamp device); switching production drawings in sufficient number of views with appropriate labeling and providing a measure of dimensions, making components, filling tables in the drawing, drafting workshop drawings for at least three part of the circuit which are connected together; numbering workshop drawings in accordance with the numbering of the assembly. Creating 3D model for three possible models for the (complex) mechanical parts, development of appropriate technical drawings in a sufficient number of views, using reflective section; application of particular views and cross sections; dimensioning; indication the quality of roughness.

prerequisite
No condition.

learning resources

S. Đorđević: INŽENJERSKA GRAFIKA,
S. Đorđević, D. Petrović: INŽENJERSKA GRAFIKA -Praktikum za vežbe-

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 30
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 40
laboratory exercises: 25
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 20

references
Food Processing Engineering Practice (B.Sc.)

ID: BSc-0212  
teaching professor: Петровић В. Драган  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 1  
final exam: oral  
parent department: theory of mechanisms and machines

goals

1. Introduction to material science necessary for application in manufacturing of food processing machinery.  
2. Practical application of knowledge in engineering graphics and solid-modeling.  
3. Developing creative capabilities in students for designing food processing machinery, machines and systems with structural analysis and exploiting characteristics of food processing machines and plants.

learning outcomes

Mastering the study program the student obtains abilities:  
1. Analysis of existing solutions and their effects  
2. Adopting practical knowledge  
3. Application of knowledge in practice  
4. Knowing and understanding the problematic of technological steps in food processing manufacturing.

theoretical teaching

Introduction to the subject. Food processing industry as an important branch of the countries industry. Classification within the food processing industry into groups and subgroups. Basic characteristics of individual groups and subgroups. Basic technological steps in manufacturing food products. Production of flower, sugar, eatable oils, fats etc. Processing of fruit and vegetables. Manufacturing milk and dairy products. Manufacturing meat and meat products. Manufacturing bakery, candy and confectionary products. Manufacturing of pastas. Manufacturing of alcoholic and non-alcoholic beverages.

practical teaching

Introduction to the manufacturing process in work organizations which are involved in the manufacturing of food processing items. Touring companies which are involved in designing and constructing of plants, as well as equipment for manufacturing of food processing commodities. Touring companies which are involved in the production of food processing industry. Introduction to the production process and informative introduction to the basic equipment in the food processing industry. Introduction to the essential technological operations in the food processing industry. Completion of the seminary work based on the experience gained in the companies. Overview and grading of the seminary work (practice logs) which encompass the covered curriculum.

prerequisite

There are no additional requirements for attendance of Food Processing Engineering Practice (B.Sc.)

learning resources
For successful mastering of the subject usage of Internet resources, instruction material available to producers and users of food processing equipment and video recordings is necessary. Instructions for writing daily practice logs and seminars.

**number of hours**

total number of hours: 46

**active teaching (theoretical)**

lectures: 18

**active teaching (practical)**

auditory exercises: 8
laboratory exercises: 0
calculation tasks: 0
seminar works: 10
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 6
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 4

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 20
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 50
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

**references**
Hidraulic and Pneumatic Mechanisms and Piping

ID: BSc-0252

teaching professor: Миладиновић Д. Љубомир

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: theory of mechanisms and machines

goals

Acquisition of all necessary knowledge for the development and calculation of pneumatic and hydraulic installations. Presentation of all symbols for both fields. The use of hydraulic and pneumatic components as a drive for modern machines in different branches. Using pneumatics as factory energy. Regulations and standards for the development of the central pneumatic distribution.

learning outcomes

At the end of this course the student should be able to interpret the pneumatic and hydraulic schemes. To be able to design mechanisms and electro pneumatic systems for synchronization of machines. It also should be able to design hydraulic mechanisms, i.e. driving systems for machines and devices.

theoretical teaching


practical teaching


prerequisite

To attend classes of the subject Hidraulic and Pneumatic Mechanisms and Piping, no condition is necessary.

learning resources

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 15
calculation tasks: 0
seminar works: 9
project design: 0
consultations: 6
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 4
check and assessment of seminar works: 4
check and assessment of projects: 0
colloquium, with assessment: 2
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 5
test/colloquium: 20
laboratory exercises: 25
calculation tasks: 0
seminar works: 20
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
Mechanism Design

ID: BSc-0655

**teaching professor:** Стоименов Д. Миодраг  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** theory of mechanisms and machines

**goals**

Mastering the necessary knowledge and develop creative skills to design and construct mechanisms within machinery and equipment. Mastering some of the software programs for construction of a concrete mechanism (machinery and equipment), and analyze their work in order to eliminate deficiencies.

**learning outcomes**

Successful completion of the study program the student receives the following subject-specific skills: understanding problems in the theory of mechanisms and machines; solving concrete problems by using scientific methods and use of appropriate software.

**theoretical teaching**

Introduction to the Theory of mechanisms, structure, mechanism, kinematic member, a kinematic pair, kinematic chain, the number of degrees of freedom of movement, basic mechanism, the formation of a complex mechanism, a group of Assur; Grashof conditions, the plane and spatial mechanisms, kinematics of mechanisms, the current center of rotation, speed kinematic pairs, kinematic angular velocity members. Acceleration of kinematic pairs, the angular acceleration of kinematic members, dynamics of mechanisms, external and inertial forces and moments in the mechanism, driving force (moment), Zhukovsky theorem, the forces (pressures) in the kinematic pairs of mechanisms of synthesis, the optimal synthesis of mechanisms in MATLAB software; the optimal parametric synthesis of mechanisms, the objective function, restrictions and punitive functions in the objective function; real mechanisms, friction and angles of friction in kinematic pairs.

**practical teaching**

The structure of mechanisms, kinematic member, a kinematic pair, kinematic chain, Understanding the work of the working model-in, by modeling, modeling of kinematic pair, kinematic chain modeling, selection and configuration facility, precision adjustment mechanism, sensing the position of kinematic pairs or members, the current reading kinematic velocity and angular velocity of pairs of members, establishing speed chart in the cycle mechanism, kinematic pairs of reading acceleration and angular acceleration member, forming a diagram of acceleration; Entering external forces and torques in a mechanism, setting the drive mode; Introduction and setting the coefficient of friction and the radius of the kinematic pair, sensing forces in kinematic pairs, the formation of force diagram in the series, Introduction to MATLAB software, writing a part program for the synthesis in MATLAB software; Parametric optimal synthesis of mechanisms for a given path (MATLAB) design obtained by synthesis mechanism by WORKING MODEL software.

**prerequisite**

No condition.
learning resources

A.Sekulić: Mechanism Design
B.Gligorić: Mechanisms
WORKING MODEL-Software Package

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 0
laboratory exercises: 18
calculation tasks: 0
seminar works: 0
project design: 12
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 35
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 35
final exam: 30
requirements to take the exam (number of points): 25

references
thermal power engineering

Industrial Practice - Thermal Power Engineering
Introduction to Energetics
Industrial Practice - Thermal Power Engineering

ID: BSc-0063

teaching professor: Петровић В. Милан

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 1

final exam: oral

parent department: thermal power engineering

goals

The aim of this course is to introduce students to the process of design and analysis of thermal power plants, processes and systems, power equipment manufacturing process, methods of calculation and analysis of mechanical and thermal loads of energy equipment, technological lines of production, quality control, organization of construction methods, maintenance schedules and technological systems at power plants, transportation, power equipment, modern methods of calculation.

learning outcomes

The successful completion of course students are introduced to: the appropriate energy processes, major and minor technological systems, the spatial distribution of equipment, methods, process analysis, measurement of process parameters, facilities management systems, etc.

theoretical teaching

Introduction. The role and importance of professional practice in thermal power engineering education.
Basics of the measures of security and safety when using equipment and resources to work in general and particularly in the field of thermal energy.
Basic principles of thermal turbomachinery.
Fundamentals of technological processes in power plants.
Steam turbine plants. Boiler installations. Auxiliary systems.
Organization of work in a power plant. Sectors and services.
Measurement and regulation equipment in thermal power.
Instructions for keeping a diary.

practical teaching

Organization of visits to factories and
• design and consulting organization in the field of energy,
• organizations that produce and maintain equipment,
• organizations that build and maintain power plants and power plants,
• power plants and other power plants,
where part of the practice are held in the Faculty of Mechanical Engineering in the laboratories of the Department for thermal power engineering.
In the laboratories of the Department for thermal students become familiar with the available equipment and measuring devices. In an independent work, students completing the technical report process with practice.

prerequisite

There are no preconditions
learning resources

Petrovic, M.: Instruction for steam turbine projet, Belgrade, 2004
Petrovic, M.: Scripts and handouts for Steam turbines

number of hours

total number of hours: 46

active teaching (theoretical)

lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 20
test/colloquium: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 50
project design: 0
final exam: 30
requirements to take the exam (number of points): 25

references

Stojanovic, Thermal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
Introduction to Energetics

**ID:** BSc-0406  
**teaching professor:** Стевановић Д. Владимир  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** thermal power engineering

**goals**

The aim is to obtain academic knowledge about the processes and equipment for exploitation of fossil fuels’ primary energy, hydropower, nuclear power, geothermal, solar and wind energy, conversion and transformation of primary into secondary energy forms, such as heat, mechanical work, electricity, transport as well as distribution of energy and working fluid, energy storage, and utilization of energy in final consumption for heating, air conditioning and refrigeration.

**learning outcomes**

Students acquire basic knowledge of technological systems, energy equipment and processes in thermal power plants, hydro power plants, boiler plants, nuclear power plants and heating systems, refrigeration and air conditioning systems. Students become familiar with the processes and technical solutions of turbomachinery, such as water turbines, steam and gas turbines, pumps, fans and compressors, as well as advanced methods and solutions for efficient energy consumption, environmental protection and analysis of macroenergy system.

**theoretical teaching**

Macroenergy systems and energy flows. Energy, economic and technological indicators of the energy system. Energy of fluid flow, the basic operating principles of turbomachinery, a classification according to the direction of energy transfer, the type of fluid. Pumps and pumping stations. Hydroenergy plants and hydraulic machines. The basic operating principles of steam turbines and their application. The basic operating principles of gas turbines and their application. Thermal power plants and the outline of the main and auxiliary technological systems. Heat and electricity co-generation. Environmental protection in thermoenergetics. Boiler plants, boilers and appliances. Application of boilers. Appliances and furnaces for burning solid (coal, biomass, urban waste), liquid and gaseous fuels. Machines for cooling/refrigeration, natural and artificial cooling. The processes and equipment for obtaining low temperatures. Systems for heating, ventilation, air conditioning and hot water. The energy efficiency in heating and air conditioning. New and renewable energy sources.

**practical teaching**

Energy consumption in the World and in Serbia. Examples of development of pumps, fans and water turbines. Demonstration of pumps with corresponding fittings in laboratory installation. Hydropower plants. Heat and technological schemes, the basic systems and components of steam power plants. Gas turbines application in energetics and transport. Examples of combined cycle power plants. The calculation of fuel consumption and thermal power plants’ efficiency. Emissions of exhaust gasses and environmental protection in thermoenergetics. A visit to a thermal power plant or a laboratory. Chronological development of steam boilers. Classification of heat boilers according to heat carrier (hot water, pressurized water and steam). Basic components of the boiler. Applications of refrigerant equipment and heat pumps. Energy consumption for heating of flats in Belgrade. Calculation of annual energy consumption for heating of various types of housing and different levels of thermal insulation.
Examples of energy efficiency in the field of air conditioning, heating and refrigerant systems in the World and in Serbia.

prerequisite

It is advisable to have passed the following exams: Mathematics 1 and Physics and measurements.

learning resources

Course handouts.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 70
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
thermal science engineering

Basic of Refrigeration
Heating Technics Basics
Heating technique fundamentals
Pipelines
Professional practice B - TTA
Steam Boiler Basics
Basic of Refrigeration

ID: BSc-0029

teaching professor: Коси Ф. Франц

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: thermal science engineering

goals

Achieving of competence and academic skills as well as methods for their acquisition. The development of creative abilities and practical skills which are essential to the profession. Objectives are concrete and achievable and in full accordance with the defined basic tasks and objectives of the study program.

learning outcomes

Student acquires subject-specific abilities that are essential for the quality of professional activities: analysis, synthesis and prediction of solutions and consequences; application of knowledge in practice; linking the basic knowledge in various fields with their application to solve specific problems.

theoretical teaching

Natural and artificial Refrigeration, Application of refrigeration and heat pumps, Methods of producing Low Temperatures, Air cycle refrigeration systems, Ideal reverse Brayton cycle, Vapour compression refrigeration systems, The Carnot vapour compression refrigeration cycle, Standard vapour compression refrigeration system, Modifications of standard vapour compression cycle, (subcooling, multistage throttling, multistage compression with intercooling), Multi-evaporator system with individual compressor, Cascade systems, The specific refrigeration effects, Refrigerants, Primary and secondary refrigerants, Refrigerant selection criteria, Designation of refrigerants.

practical teaching

Auditory training: thermal insulation, selection of insulation materials, the diffusion of water vapor through thermal insulation layer, vapour barrier, calculation of refrigeration load, thermodynamic analyses of refrigeration cycle; Laboratory Exercise: Demonstration of refrigeration devices in industrial plants; Design project of refrigeration system: work in groups of 5 students (for a particular object and refrigerant), calculation and selection of insulating structures, refrigeration load, thermodynamic calculation of refrigeration cycle.

prerequisite

Required exams passed: Thermodynamics B; desirable Passed Exam: Fluid Mechanics B

learning resources

Textbook: M. Markoski: Air-conditioning, Mechanical Engineering, 2006, "Handouts" which will be available in advance for each week of classes

number of hours

total number of hours: 75
active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 5
calculation tasks: 0
seminar works: 0
project design: 15
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 50
requirements to take the exam (number of points): 21

references
Heating Technics Basics

ID: BSc-0257  
teaching professor: Живковић Д. Бранислав  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 6  
final exam: written+oral  
parent department: thermal science engineering

goals

Acquiring knowledge and skills in the field of heating technique- the impact of climate parameters and conditions of comfort, heating bodies, additional elements and equipment, types and modes of heat transfer; acquiring knowledge of methods for heat losses calculations according to different standards, and use these methods when creating a main design of the central heating system.

learning outcomes

Students acquire specific skills and knowledge in heating technique: student is familiar with elements of central heating system, known calculation methods of heat losses calculation and can apply them in practice. The student connects basic knowledge and apply it to solve concrete problems in the heating technique.

theoretical teaching

Thermal parameters of the environment; comfort conditions, characteristics of the external climate and the impact on thermal comfort requirements, calculation methods of external design temperature for heating, heat transfer through the building envelope, thermal bridges, condensation, natural ventilation, wind effect on air infiltration; estimating heating capacity using different standards, radiators and valves, types of heat transfer, radiators heat output depending on the temperature of fluid; heaters testing, sources of heat in central heating systems, boiler safety equipment and fittings, boiler and its elements, open and closed expansion vessel, annual energy consumption for heating calculation, the calculation of fuel consumption, types of central heating systems.

practical teaching

Auditory exercises consists of several parts: heat transfer through the building envelope, determining the thickness of insulation for facade walls, roofs and floors, ventilation and transmission heat losses and sizing of heating bodies, boilers and related equipment, with the aim of making solo project task. Laboratory exercise is a demonstration - elements of central heating installations, fittings, pipe insulation, radiator thermal properties testing. It is envisaged to visit the techniques fair or factory which produces heating equipment.

prerequisite

Student must have been passed exam in thermodynamics.

learning resources

Lecture handouts

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 5
calculation tasks: 0
seminar works: 0
project design: 15
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 50
requirements to take the exam (number of points): 21

references

B. Todorovic: Designing systems for central heating, Faculty of Mechanical Engineering, Belgrade, 2007.
Heating technique fundamentals

ID: BSc-0646
**teaching professor:** Тодоровић Н. Мaja
**level of studies:** B.Sc. (undergraduate) academic studies
**ECTS credits:** 6
**final exam:** written+oral
**parent department:** thermal science engineering

**goals**

Acquiring knowledge and skills in the field of heating technology - the impact of climate parameters and conditions of comfort, heating bodies, additional elements and equipment, types and mechanisms of heat transfer; acquiring knowledge of methods for calculation of heat losses according to different standards and use these methods when developing main mechanical project of central heating systems.

**learning outcomes**

Students acquire specific skills and knowledge in heating technology: they are familiar with elements of central heating systems; familiar with heat losses calculation methods and can apply them in practice. Student can connect basic knowledge and apply it to solve concrete problems in the technique of heating.

**theoretical teaching**

Thermal parameters of the environment; comfort conditions, characteristics of the external climate and the impact on thermal comfort conditions; calculation method for external project temperature heating; heat transfer through the building envelope construction, heat bridges, condensation, natural ventilation, wind effect on air infiltration, calculation of needed amount of heat for heating using different standards, heating equipment division, radiators and valves, types of heat transfer, heat radiators disclosure depending on the temperature of fluid; testing heaters; heating sources in central heating systems, insurance and boiler fittings, boiler room and its elements, open and closed expansion vessel; annual energy consumption calculation, the calculation of fuel consumption, different systems of central heating.

**practical teaching**

Auditory exercises consisting of several parts: heat transfer through the building envelope construction, determining the thickness of insulation, ventilation calculation of transmission and heat loss and sizing of heaters, boilers and related equipment, with the aim of making solo project task. Laboratory exercise is a demonstration - elements of the installation heating, valves, pipe insulation, thermal properties testing radiator. It is envisaged to visit the fair and techniques or factory that manufactures heating equipment.

**prerequisite**

If a student could follow the subject must have passed the exam in Thermodynamics B.

**learning resources**

Handouts - M. Todorović
Central heating systems design - B. Todorović
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 5
calculation tasks: 0
seminar works: 0
project design: 15
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 50
requirements to take the exam (number of points): 21

references

B. Todorović: Central Heating Systems Design, Faculty of Mechanical engineering, Belgrade 2009.
Pipelines

ID: BSc-0073

**teaching professor:** Коси Ф. Франц

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** thermal science engineering

**goals**

Achieving of competence and academic skills as well as methods for their acquisition. The development of creative abilities and practical skills which are essential to the profession. Objectives are concrete and achievable and in full accordance with the defined basic tasks and objectives of the study program.

**learning outcomes**

Student acquires subject-specific skills that are functional quality performance of professional activities: analysis, synthesis and forecasting solutions and consequences, in-depth knowledge and understanding of the profession, connecting of basic knowledge in various fields and their application to solve specific problems, monitoring and implementation of innovations, skills for development and the use of knowledge.

**theoretical teaching**

Basic concepts; Corrosion and corrosion protection; Influence of high and low temperatures on pipe materials, Flange joints, Piping components, Piping supports; Temperature dilatations compensation of pipelines; Thermal stress Analysis of pipelines, Piping Layout, Piping Supports, Flow of Fluids.

**practical teaching**

Auditory training: Practical demonstration (description and examples of design elements of the pipeline, standardization and typing of pipelines, manufacturing of metallic piping, fabrication and installation of piping, application of the piping components); Numerical problems: analysis and calculation of flange joints, temperature dilatation and thermal stress calculation, flow of vapour and gases in pipelines.

**prerequisite**

Required exams passed: mechanical engineering materials, material stress science and thermodynamics; desirable passed the test: mechanics of solid

**learning resources**

Textbook: M. Markoski: Pipelines (Faculty of Mechanical Engineering, 2006), "Handouts" which will be available in advance for each week of classes

**number of hours**

**total number of hours:** 75

**active teaching (theoretical)**

lectures: 30
active teaching (practical)

auditory exercises: 20
laboratory exercises: 0
calculation tasks: 10
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 5
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 50
requirements to take the exam (number of points): 21

references
Professional practice B - TTA

ID: BSc-0077

**teaching professor:** Тодоровић Н. Мaja

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 1

**final exam:** seminar works

**parent department:** thermal science engineering

**goals**

The aim of this course is to introduce students to the process of design and construction of HVAC systems, processes and systems, elements of the production process and HVAC systems equipment, methods of calculation used in the design of HVAC systems, introduction to the technological production lines in factories, quality control, work organization and systems maintenance.

**learning outcomes**

By the successful completion of the course students are introduced to: the elements of HVAC installations, methods of process analysis and installations design, system operating parameters measurement etc.

**theoretical teaching**

Introduction. The role and importance of professional practice in education of thermal science engineers. Basic principles of systems for heating, cooling, ventilation, air conditioning and heat generation plants. Basic processes in HVAC plants. Measurement & Instrumentation systems applied in thermal science. Instructions for daybook keeping.

**practical teaching**

Organization of visits to factories and firms • design and consulting organizations in the field of thermal engineering • organizations that manufacture machines and equipment in the field of thermal engineering • organizations involved in the maintenance, measurement and HVAC installations regulation • organizations involved in the execution of HVAC installations • companies involved in heat production and district heating plants • thermal power plants and combined heat and power production. In an independent work, students are completing the technical report of practice. The report is submitted in the form of the daybook. The final exam includes an oral defense of the daybook after practice is completed.

**prerequisite**

no conditions

**learning resources**

Handouts and documents provided by the responsible person from the company

**number of hours**

total number of hours: 46

**active teaching (theoretical)**

lectures: 5
active teaching (practical)

auditory exercises: 0
laboratory exercises: 36
calculation tasks: 0
seminar works: 4
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 1

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 0
laboratory exercises: 30
calculation tasks: 0
seminar works: 40
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references
Steam Boiler Basics

ID: BSc-0090

**teaching professor:** Живановић В. Титослав  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written+oral  
**parent department:** thermal science engineering

**goals**

Reaching the competence and academic skills and methods for it’s acquiring. Developing creative capabilities and mastering the specific practical skills. Goals determine the specific results which should be achieved within the subject. Goals also represent basis for control of the achieved results. Activities in this subject are in accordance with basic tasks and goals of the study program.

**learning outcomes**

Student acquires specific capabilities which are needed for carrying out professional activities: analysis, synthesis and anticipating the results and consequences; use of knowledge from different areas for solving specific problems.

**theoretical teaching**

Fuels for steam boilers; Combustion material balance; Excess air; Flue gases enthalpy; Working principle of a steam boiler and definitions of basic concepts; Steam boiler heat balance, losses and efficiency; Steam boiler furnace; Steam boiler evaporators with natural circulation loop; Half-radiation and convection evaporators; Radiation, half-radiation and convection superheaters; Reheaters; Different types of water heaters; Recuperative air heaters and regenerative air heaters.

**practical teaching**

Auditory exercises consist from demonstration exercises (Classification of boilers; Steam boiler construction; Main and auxiliary devices and equipment); Laboratory determination of fuel calorific value; Working project - coal combustion material balance (coal calorific value, theoretical air volume for combustion, theoretical flue gas volume, flue gases enthalpy diagram as a function of temperature and excess air); Guidelines for preparation of another project - choice of hot water and steam boiler (energy balance and definition of the boiler, the determination of fuel consumption and boiler efficiency); Visit and tour of a steam boiler in vicinity of Belgrade

**prerequisite**

Necessary condition: all exams from the first year of bachelor academic studies;  
Preferred passed exam: thermodynamics

**learning resources**

Books: Lj. Brkic, T. Zivanovic, D. Tucakovic: Steam Boilers, Faculty of Mechanical Engineering, Belgrade, 2010, (In Serbian); Lj. Brkic, T. Zivanovic, D. Tucakovic: Steam Boilers Thermal Calculation, Faculty of Mechanical Engineering, Belgrade, 2010, (In Serbian); handouts which will be at student's disposal a week in advance
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 10
consultations: 0
discussion and workshop: 10
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 4
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 30
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 30
final exam: 40
requirements to take the exam (number of points): 30

references

Lj. Brkic, T. Zivanovic, D. Tucakovic: Steam Boilers, Faculty of Mechanical Engineering, Belgrade, 2010, (In Serbian)
Lj. Brkic, T. Zivanovic, D. Tucakovic: Steam Boilers Thermal Calculation, Faculty of Mechanical Engineering, Belgrade, 2010, (In Serbian)
thermomechanics

Applied Thermodynamics
Basics of Heat Transfer
Steady state problems in heat transfer
Thermodynamics B
Applied Thermodynamics

ID: BSc-0215

teaching professor: Банац Ј. Милош

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written+oral

parent department: thermomechanics

goals

Going through the thermodynamic analysis, students should gain a basic theoretical and professional knowledge about devices and facilities that are used in area of thermo-technique, thermo-energetic and processes engineering, as well as to gain knowledge of the physical phenomena that take place with the processes in steam turbines, gas turbines, refrigeration systems, systems for drying different materials and air conditioning systems.

learning outcomes

Creating the skills for recognizing, understanding and analysing of thermodynamic problems and gaining knowledges and skills necessary to carry out the common thermodynamic calculations simpler thermo-mechanical devices and facilities that are used in the area of thermo-technique, thermo-energetic and processes engineering. These gains skills will be a necessary base of knowledge for active attend lectures on other scientific-professional and professional-application subjects.

theoretical teaching

1. The First law of thermodynamics for open systems. Energy balance for unsteady flow process
2. The Second law of thermodynamics for open systems. The increase of entropy princip.
3. The thermodynamic analysis usual thermo-mechanical devices and equipment.
4. The thermodynamic analysis usual thermo-mechanical facilities and systems. Heat engines and facilities that work acording to power cycles and facilities that work acording to refrigeration cycles.
5. Moist air - equipment and facilities that work with moist air. Systems for drying different materials and air conditioning systems.

practical teaching

1. Problems and examples in connection with the First law of thermodynamics for open systems.
2. Problems and examples in connection with the Second law of thermodynamics for open systems.
3. Problems and examples in connection with the thermodynamic analysis of usual thermo-mechanical devices.
4. Problems and examples in connection with the thermodynamic analysis usual thermo-mechanical facilities.
5. Problems and examples in connection with processes, equipment and facilities that work with moist air - systems for drying different materials and air conditioning systems.

prerequisite

Passed exams in subject: Physics and measurements and Thermodynamics B
learning resources

3. Handouts (Prof. Dr. Milos Banjac), available in electronic form (in Serbian)

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 20
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 2
discussion and workshop: 8
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 8
test, with assessment: 2
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 25

references
Voronjec, D., Kozic, D.: Moist Air, SMEITS, Belgrade, 2005. (in Serbian)
Basics of Heat Transfer

ID: BSc-0532
teaching professor: Саљников В. Александар
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: written+oral
parent department: thermomechanics

goals

Students shall gain knowledge in heat transfer - scientific discipline that is fundamental for design of devices and plants in process engineering, thermal engineering and power engineering. Students shall study steady-state and transient heat conduction, forced and free heat convection as well as boiling and condensation heat convection; also study radiation heat transfer as well as influence of all these phenomena upon the climate changes and global warming.

learning outcomes

After completing the course, passing quizzes and tests and successfully passing the final exam, students shall be able to perform, themselves, thermal calculations of simple thermal engineering plants and unitary devices. Result of the course is also acquiring basic knowledge that enable active participation in related theoretical and applied courses.

theoretical teaching

1. Heat conduction - basic mechanisms, Fourier law, Fourier differential equation; thermal diffusivity, boundary conditions of first, second and third kind, initial conditions.
2. Steady-state conduction; critical thickness of pipe insulation; rods and fins. Transient conduction - lumped capacitance body, semi-infinite solid; numerical methods.
3. Heat convection - forced and natural convection; similarity theory, boundary layer equations, differential and integral equations, boiling and condensation convective heat transfer.
4. Heat exchangers - mean logarithmic temperature difference method; method of heat exchanger efficiency and number of heat transfer units (ε-NTU method);
5. Radiation heat transfer - basic mechanisms, wave and quantum theory, fundamental laws; radiation exchange between 2 surfaces with intermediate two atomic (thermally transparent) gas or mixture of CO2 and H2O i.e. the "greenhouse effect" gases.

practical teaching

1. Numerical exercises: steady-state conduction; bodies with inside heat sources, critical thickness of pipe insulation; rods and fins.
2. Numerical exercises: transient conduction - bodies with finite thermal resistance, lumped capacitance bodies, semi-infinite solid; numerical methods.
3. Numerical exercises: forced and natural convection; determining Nusselt number and heat convection coefficient, boiling and condensation convective heat transfer.
4. Numerical exercises: heat exchangers - mean logarithmic temperature difference method; method of heat exchanger efficiency and number of heat transfer units (ε-NTU method);
5. Numerical exercises: radiation exchange between 2 surfaces with intermediate; A) two atomic (thermally transparent) gas; B) mixture of CO2 and H2O i.e. the "greenhouse effect" gases.

prerequisite
Necessary: Physics, Thermodynamics B
Desirable: Hydraulics and pneumatics (Fluid mechanics)

learning resources

1. Handouts for heat and mass transfer, site of Mašinski fakultet, Beograd.

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 20
laboratory exercises: 0
calculation tasks: 5
seminar works: 5
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 5
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 0
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 40
requirements to take the exam (number of points): 20

references

486
Steady state problems in heat transfer

ID: BSc-0668  
teaching professor: Коматина С. Мирко  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 6  
final exam: written+oral  
parent department: thermomechanics

goals

Students will acquire theoretical and applied (practical) knowledge on steady state problems in heat transfer. Based upon the acquired knowledge they will be ready to recognise and solve the applied (practical) problems encountered in engineering practice, especially in the areas of process-, HVAC- and thermal power engineering. Students will acquire knowledge in steady state heat conduction, heat convection and heat transfer by boiling and condensation, heat exchanger design and radiation heat transfer.

learning outcomes

After attending lectures, completing the pre-examination activities and successfully passing the exam, the students will be ready to perform thermal calculations of simple process engineering-, HVAC engineering-, and thermal power engineering installations and single units. This course will give to the students a sound theoretical and applied (practical) basis for active participation in courses on related theoretical and applied engineering subjects in our school and elsewhere.

theoretical teaching

1. Conduction heat transfer (heat conduction) – basic definitions, Fourier’s law, Fourier’s differential equation;  
2. Steady state heat conduction problems: plane and cylindrical wall, bars and fins.  
3. Convection heat transfer: forced and free heat convection; heat convection by boiling and condensation.  
4. Heat exchangers: a) mean log temperature difference method; b) heat exchanger efficiency – number of heat transfer units method ($\varepsilon$ – NTU method).  
5. Heat transfer by radiation (thermal radiation) – basic mechanisms, wave and quantum theory, basic laws; radiation between two surfaces.

practical teaching

2. Numerical exercises: forced and free convection: determining the Nusselt number and the convection heat transfer coefficient, heat convection by boiling and condensation.  
3. Numerical exercises: a) mean log temperature difference method; b) heat exchanger efficiency – number of heat transfer units method ($\varepsilon$-NTU method).  

prerequisite

Physics

learning resources
1. Хендаути. Handouts

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 20
laboratory exercises: 0
calculation tasks: 0
seminar works: 2
project design: 0
consultations: 3
discussion and workshop: 5
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 2
check and assessment of projects: 0
colloquium, with assessment: 5
test, with assessment: 3
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 5
project design: 0
final exam: 35
requirements to take the exam (number of points): 20

**references**
Thermodynamics B

**ID:** BSc-0372  
**teaching professor:** Гојак Д. Милан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** oral  
**parent department:** thermomechanics

**goals**

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

**learning outcomes**

Qualifying for following and acquiring knowledge from appropriate scientific-applied fields, and ability to synthesize and apply the gathered knowledge.

**theoretical teaching**


**practical teaching**


**prerequisite**

As defined by the program of studies curriculum.

**learning resources**

1. Handouts  
2. Kozić, Đ., Vasiljević, B., Bekavac, V.: Handbook for thermodynamics, Faculty of Mechanical
Engineering, Belgrade

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 24
laboratory exercises: 0
calculation tasks: 5
seminar works: 0
project design: 0
consultations: 3
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 3
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 2
final exam: 2

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 0
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 5
seminar works: 0
project design: 0
final exam: 35
requirements to take the exam (number of points): 35

**references**
Milinčić, D., Voronjec, D.: Thermodynamics, Faculty of Mechanical Engineering, Belgrade (in Serbian)
Kozić, Đ.: Thermodynamics - engineering aspects, Faculty of Mechanical Engineering, Belgrade (in Serbian)
Vasiljević, B., Banjac, M.: Map for thermodynamics, Faculty of Mechanical Engineering, Belgrade (in Serbian)
Voronjec, D., Đorđević, R., Vasiljević, B., Kozić, Đ., Bekavac, V.: Solved problems in thermodynamics with extracts from theory, Faculty of Mechanical Engineering, Belgrade (in Serbian)
Đorđević, B., Valent, V., Šerbanović, S.: Thermodynamics with thermal engineering, Faculty of Technology and Metallurgy, Belgrade (in Serbian)
weapon systems

Classical Armament Design
Flight Mechanics of Projectiles
Fundamentals of Projectiles Propulsion
Fundamentals of Weapon System Design
Introduction to Weapon Systems
Missile Flight Mechanics
Missile weapon design
Professional Practice B - SIN
Classical Armament Design

**ID:** BSc-0057

**teaching professor:** Мицковић М. Дејан

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** weapon systems

**goals**

Introducing students to the basics of construction of artillery weapons, small arms, automatic cannons, armoured vehicles and tanks. The study of basic tactical - technical requirements, processes that occur during firing, and the principles of operation, determining the structural solutions of certain systems. Analysis of individual structural elements of different classical armament systems.

**learning outcomes**

Mastering the basic principles of the design of classical armament systems. Qualification for the calculation of basic parameters of processes that determine the design of individual systems. The basis for the later detailed study of artillery and automatic weapons design.

**theoretical teaching**


**practical teaching**


**prerequisite**

There are no special conditions for attending the subject.

**learning resources**

1. Micković D.: Classical armament design - Handouts
2. Vasiljević M.: Automatic weapons, TŠC KoV JNA, Zagreb
number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 28
laboratory exercises: 0
calculation tasks: 2
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 30

references

Handbook on Weaponry, Rheinmetal GmbH, Dusseldorf, 1982
Flight Mechanics of Projectiles

ID: BSc-0686  
teaching professor: Јарамаз С. Слободан  
level of studies: B.Sc. (undergraduate) academic studies  
ECTS credits: 6  
final exam: written  
parent department: weapon systems  

goals

Introducing students to the fundamentals of flight mechanics, including aerodynamics, and its tasks. Setting up basic equations of flight dynamics and principles of the solutions. Basic knowledge about the forces and moments acting on the projectile during flight. The behavior of the projectile in the path regarding to: the stability of missiles, missile control principles. Application of software packages for the mechanics of flight. The application of flight mechanics: a preliminary design of weapons, firing tables, fire control systems, control software.

learning outcomes

Knowledge of principles and fundamental equations of flight mechanics of projectiles. Ability to work with application software for the calculation of aerodynamic coefficients and flight mechanics of missiles. Basic knowledge of stability and the principles of control of missiles.

theoretical teaching

Introduction to the flight mechanics of projectiles; the basic concepts.  
The basic tasks of flight mechanics (primary task and reversible task).  
External conditions (the Earth's atmosphere and gravitational field).  
Coordinate frames (inertial and noninertial coordinate frames).  
Basic flight mechanics equations (Newton's and Euler's equation).  
Forces and torques acting on projectile (gravitational, aerodynamic, propulsion and control).  
Aerodynamics as a special area of mechanics of flight; basic principles of environment influence on the missile.  
Aerodynamic coefficients and gradients.  
Method of aerodynamic calculation. Aerodynamic design.  
Software packages for aerodynamic design (DATCOM). Basic flight mechanics calculation method (approximate and numerical).  
The behavior of the projectile - the stability and maneuverability, static and dynamic stability, gyroscopic stability.  
Guided missiles and guidance and control systems (fundamentals).  
Software packages to model the flight dynamics (6DOF and CADAC).  
The preliminary design of projectiles.  
Ballistic tables and firing tables.  
Fire control systems and control software.

practical teaching

Earth's atmosphere and gravitational field (examples).  
Coordinate systems, transformations matrices (examples).  
The basic equations of flight mechanics of projectiles, forces and moments acting on the projectile (examples).  
Approximate methods (Euler's method, Siacci's method, Ciolkovski's method).  
Aerodynamic calculation methods. Aerodynamic design (calculation examples).
Application of software package for aerodynamic design (DATCOM).
The basic methods of mechanics of projectiles flight calculations (examples of approximate and numerical calculations).
Application software package for modeling the flight dynamics of projectiles (6DOF and CADAC).
Preliminary design of projectiles (example).
Application of ballistic and firing tables.

**prerequisite**

**learning resources**


**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 10
laboratory exercises: 0
calculation tasks: 10
seminar works: 0
project design: 10
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 5
colloquium, with assessment: 5
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 20
final exam: 50
requirements to take the exam (number of points): 25

**references**
Fundamentals of Projectiles Propulsion

**ID:** BSc-0092  
**teaching professor:** Јарамаз С. Слободан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** weapon systems

**goals**

Introducing students to the basics of projectile propulsion, including classic and rocket propulsion. Study of fundamental processes that occur during firing in the gun barrel and in the rocket motor chamber. Influence of characteristics of propellants on firing processes. Setting up a system of equations describing these processes and methods for solving the system. Application of propulsion software packages. Design of propellant systems.

**learning outcomes**

Mastering the calculation of basic parameters of interior ballistics and rocket propulsion. Knowledge of principles and basic equations of the propulsion. Capability to work with application software for propulsion systems modeling. Fundamentals for subsequent detailed study of various types of propulsion.

**theoretical teaching**

1. Introduction to propellant systems.  
2. Classification of propulsion systems (classical and rocket).  
4. Basic processes and laws during the firing process. The main tasks of the internal ballistics.  
6. Basics of reactive propulsion; classification of reactive propulsion (air-breathing and rocket); classification of rocket propulsion (liquid, solid and hybrid).  
7. The basic equations of propulsion systems performances.  
10. Fundamentals of rocket motors with solid propellants.  

**practical teaching**

1. Combustion of gunpowder. Examples of calculations  
4. The basic equations of propulsion systems performances. Problems  
5. Fundamentals of rocket engines with liquid propellants. Selected examples  
6. Fundamentals of rocket propulsion with solid propellants. Selected examples  
7. Software packages for reactive motor performance calculation. Examples and demonstrations.

**prerequisite**
No obligatory prerequisites. Passes exam preferred: Fundamentals of weapon system design

learning resources


number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 12
laboratory exercises: 6
calculation tasks: 12
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references
Fundamentals of Weapon System Design

ID: BSc-0408

**teaching professor:** Мицковић М. Дејан

**level of studies:** B.Sc. (undergraduate) academic studies

**ECTS credits:** 6

**final exam:** written

**parent department:** weapon systems

**goals**

Students should have the basic knowledge of the general methods of weapons systems design. The goal is to provide students with an integrated overview of the most important fields of defense technology and appropriate methods of design and construction. The subject should serve as a basis for a thorough study of individual areas of weapons systems.

**learning outcomes**

Students should obtain the basic knowledge of the general methods of weapons systems design. The goal is to provide students with an integrated overview of the most important fields of defense technology and appropriate methods of design and construction. The subject should serve as a basis for a thorough study of individual areas in the field of weapons systems.

**theoretical teaching**

1. Introduction to methods of weapons systems design,
2. Internal ballistics (Main features of the firing process,...),
3. Rocket propulsion (Basis of reactive propulsion and division,...),
4. Aerodynamics of the projectile (Fundamentals of aerodynamics, ...),
5. Projectile flight dynamics (main tasks of the projectile flight dynamics,...),
6. Construction of projectiles (projectile safety during movement through the gun tube, ...),
7. Construction of artillery weapons (barrel, muzzle brake, breechblock,...),
8. Construction of automatic weapons,
9. Construction of missiles (Basic equations spending rocket fuel and missile movements, ...),
10. Construction of rocket launchers (rocket launch types and main characteristics, ...),
11. Optical instruments and sighting devices (theory of light and geometric optics,...).

**practical teaching**

1. Internal ballistics - examples
2. Rocket propulsion - examples
3. Projectile Aerodynamics - examples of calculations
4. Projectile flight dynamics - examples of calculations
5. Construction of projectiles - solving problems
6. Construction of artillery weapons - examples, analysis and comparison
7. Construction of automatic weapons - examples, analysis and comparison
8. Construction of missiles - examples of calculations
9. Construction of rocket launchers - examples of calculations
10. Optical instruments and sighting devices - examples and calculations

**prerequisite**

There are no special conditions for attending the subject.

**learning resources**
1. Jaramaz S., Blagojevic D., Milinovic M., Mickovic D.: Handouts

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 20
laboratory exercises: 5
calculation tasks: 5
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references
Introduction to Weapon Systems

**ID:** BSc-0210  
**teaching professor:** Јарамаз С. Слободан  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** written  
**parent department:** weapon systems

**goals**

The main objective of this course is to introduce students to the field of weapon systems. Students get basic knowledge in the field of defense technologies, and learn the classification, purpose, importance and basic principles underlying the modern weapon systems. Gain insight into the complexity and variety of weapon systems and get a clear overview of this multidisciplinary field.

**learning outcomes**

Student gets the necessary basic knowledge of weapons systems that include classification, purpose and key principles of their action. By connecting the learning to previously acquired knowledge, a student has a complete overview of the field of weapon systems.

**theoretical teaching**

1. Development of conventional weapons systems,  
2. Classic weapons (small arms, artillery weapons, anti-armor systems, air-defense systems),  
3. Ammunition (division of projectiles, explosives, small arms ammunition, high-explosive missiles, KE projectiles, shaped charge projectiles, cargo ammunition, fuzes),  
4. Platform of weapon systems (tanks, classification of other armored vehicles),  
5. Rocket systems (the basic principle of rocket motion, classification and characteristics of military rocket and missile systems, the main characteristics of anti-armor missile, air-defense missiles, the main characteristics of artillery rocket systems MLRS)  
6. Data acquisition systems,  
7. Fire control systems,  
8. Guidance and control of missiles.

**practical teaching**

1. Classic weapons - analysis and comparison of solutions implemented in practice,  
3. Ammunition - types of projectiles, the main characteristics, the analysis of realized designs  
4. Platform of weapon systems - the analysis of implemented solutions, comparison,  
5. rocket systems - fundamentals of rocket motion, types of missiles, the analysis of realized designs  
6. Data acquisition systems - examples of sensors and their analysis  
7. Fire control systems - an analysis of different types of FCS  
8. Guidance and control of missiles - Analysis and comparison of different types of guidance and control systems.

**prerequisite**

None

**learning resources**
1. Handouts for lessons

**number of hours**

total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 15
laboratory exercises: 15
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 10
test, with assessment: 0
final exam: 5

**assessment of knowledge (maximum number of points - 100)**

feedback during course study: 10
test/colloquium: 60
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

**references**
Missile Flight Mechanics

**ID:** BSc-0094  
**teaching professor:** Благојевић Ђ. Ђорђе  
**level of studies:** B.Sc. (undergraduate) academic studies  
**ECTS credits:** 6  
**final exam:** oral  
**parent department:** weapon systems

**goals**

Introducing students to the basics of flight mechanics, including aerodynamics, and its tasks. Setting up basic equations of flight dynamics and principles of the solutions. Basic knowledge about the forces and moments acting on the projectile during flight. The behavior of the projectile in the path regarding to: the stability of missiles, missile control principles. Application of software packages for the mechanics of flight. The application of flight mechanics: a preliminary design of weapons, firing tables, fire control systems, control software.

**learning outcomes**

Knowledge of principles and fundamental equations of mechanics of flight. Ability to work with application software for the calculation of aerodynamic coefficients and flight mechanics of missiles. Basic knowledge of stability and the principles of control of missiles

**theoretical teaching**

Introduction to the mechanics of flight, the basic concepts.  
The basic tasks of flight mechanics (primary task and reversible task).  
External conditions (the Earth's atmosphere and gravitational field).  
Coordinate frames (inertial and non-inertial coordinate frames).  
Basic flight mechanics equations (Newton's and Euler's equation).  
Forces and torques acting on projectile (gravitational, aerodynamic, propulsion and control).  
Aerodynamics as a special area of mechanics of flight; basic principles of environment influence on the missile.  
Aerodynamic coefficients and gradients.  
Method of aerodynamic calculation. Aerodynamic design.  
Software packages for aerodynamic design (DATCOM). Basic flight mechanics calculation method (approximate and numerical).  
The behavior of the projectile - the stability and maneuverability, static and dynamic stability, gyroscopic stability.  
Guided missiles and guidance and control systems (bases).  
Software packages to model the flight dynamics (6DOF and CADAC).  
The preliminary design of projectiles.  
Ballistic tables and firing tables.  
Fire control systems and control software.

**practical teaching**

External conditions (the Earth's atmosphere and gravitational field).  
Coordinate frames (inertial and non-inertial coordinate frames).  
Basic flight mechanics equations (Newton's and Euler's equation).  
Forces and torques acting on projectile (gravitational, aerodynamic, propulsion and control).  
Aerodynamics as a special area of mechanics of flight; basic principles of environment influence on the missile.
Aerodynamic coefficients and gradients.
Method of aerodynamic calculation. Aerodynamic design.
Software packages for aerodynamic design (DATCOM).
The behavior of the projectile - the stability and maneuverability, static and dynamic stability, gyroscopic stability.
Software packages to model the flight dynamics (6DOF and CADAC).
The preliminary design of projectiles.
Ballistic tables and firing tables.

prerequisite
none

learning resources
Djordje Blagojevic, Missile flight dynamics, manuscript
Djordje Blagojevic, Missile Aerodynamics, manuscript

number of hours

total number of hours: 75

active teaching (theoretical)

lectures: 30

active teaching (practical)

auditory exercises: 20
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 10
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 6
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 4
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 0
calculation tasks: 20
seminar works: 0
project design: 0
final exam: 50
requirements to take the exam (number of points): 20

references
Missile weapon design

ID: BSc-0254

teaching professor: Милиновић П. Момчило

level of studies: B.Sc. (undergraduate) academic studies

ECTS credits: 6

final exam: written

parent department: weapon systems

goals

Goal of subject is to achieve competitive academic knowledge and skills in the analyzes and syntheses of the main missiles and rocket system performances. Also, goal is to realize knowledge about special missile and rocket performances, as the special flight vehicle and ballistic object, with their distinguishing features, applicable for weapon or ammunition syntheses comparing with other types of weapon and projectiles. Student or applicant developing creative capabilities, in the directed mechanical engineering, skills for the basic professional orientation of weapon design engineering. Theoretical applications and practical examples of missile, rockets diversification and integration design cases is the knowledge goal of student creative course work, as the bachelor basic knowledge of weapon designers.

learning outcomes

Student achieve possibilities of analyzes and syntheses for the expert solutions of weapon missile and rocket systems, project, design, feasibility and other study approaches integrations. Output includes methodology and proceedings of specific research knowledge of mathematics, mechanics, propulsion, propellants and its software applications in missiles systems design. Student developing critical approach of weapon missiles system and design and possibility to employ knowledge in practical work also, in information exchanging about relevant references. Also, understand principal performances of missiles and rocket weapon systems and differences its design differences and applied different technologies and branches of research in this area.

theoretical teaching

1. Subtopics
   Defense efficiency and role of missiles and rockets in military technology.
   1. Types and diversification of missiles and rocket projectiles, and its basic subsystems components and main parts. Components and subsystems principal functions, and performances integration and analyses. Functional design of missiles and rockets and differences in flight and componential content.

2. subtopics
   Mass model and Tziolkowsky velocities of missiles and rockets, payload analyses for rocket, and special for missiles and its differences. Basic propulsion and rocket engines integration performances. Dimensions, gravity centers, and inertial properties of missiles and rockets. Design concept of aerodynamically and components and frames, energetic concept, and flight range, height, precision and ballistic requirements, for missiles and special for rockets.

3. Subtopics
   Forces, aerodynamically, gravity, propulsion and control guidance, their moments, as the loads, on the start during launching, in the flight and in the terminal phase. Basic principles of internal and external strain and stress analyzes of missiles body and components.

4. Subtopics
   Multilaunching missiles and rocket systems, separation phases, payloads on the launching and in the flight, separation of start systems and mass models analyzes.
5. Subtopics
Launching mechanics stability, basic launching system components, and functions and weapon systems diversifications in launcher, missiles, and rockets flight integration.

**practical teaching**

1. Design of technical and functional requirements of the missile and rocket systems
   Precision and accuracy of missiles and rockets and employment capabilities.
   Integration of missiles and rockets with different subsystems in the missile body.

   Practical calculation performances
4. Stability of launching and mass model development of the weapon system, and missile.
   Calculation examples.

5. Concept of development of seminar paper for probability study of rocket or missile systems from the references of weapon. Presentation and text paper.
6. Experimental testing of missile properties, frame plan of performances evaluation

**prerequisite**

none

**learning resources**

1. M. Milinovic: Basics of missiles and launchers design (serb), University of Belgrade Faculty of ME 2002., textbook
2. M. Milinovic, M. Holclajtner - Basics of missiles design (serb), University of Belgrade Faculty of ME 2004., layhandout

**number of hours**

Total number of hours: 75

**active teaching (theoretical)**

lectures: 30

**active teaching (practical)**

auditory exercises: 16
laboratory exercises: 5
calculation tasks: 4
seminar works: 5
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

**knowledge checks**

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 4
check and assessment of projects: 0
colloquium, with assessment: 6
test, with assessment: 0
final exam: 5

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 20
laboratory exercises: 10
calculation tasks: 0
seminar works: 30
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references

Robert L. McCoy, Modern Exterior Ballistics, 1999 AIAA, USA
M. Milinovic missile szstems design, eng, Univ. of Belgrade, FME, layhandout, 2000.
Professional Practice B - SIN

ID: BSc-0376
teaching professor: Мицковић М. Дејан
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 1
final exam: oral
parent department: weapon systems

goals

The course teaches the student to approach the practical activities of engineers through the practical work. The student gains an opportunity to apply into practice the knowledge and skills obtained by studying the theory. By that way students would gain insight into the technical and organizational aspects of work and their mutual relationship in companies or institutions.

learning outcomes

Students will acquire practical knowledge in the field of weapons systems related to the fundamentals of design, the main production technologies, the organization of work, methods of product testing and the like.

theoretical teaching

The role and importance of professional practice in the field of weapons systems. Measures of health and safety at work in the field of explosive materials, weapons and military equipment. The basic principles of design, construction and production of weapons systems. Control and testing. Introduction to the professional practice. Guidelines on how to best use the time in companies. Instructions for keeping a diary.

practical teaching

Practical work can be done in
• military industry enterprises,
• scientific and research institutions focused on research and development of weapons systems,
• other companies.
In the military industrial enterprises, students should be concentrating on the domestic defense industry products, as well as the technologies used in the production of weapons systems. In the scientific and research institutions students should be focused on a systematic approach to problems of design and testing of weapons systems. In other companies, students should be focused on specific production technologies, issues of organization, as well as the production process and product quality control.

prerequisite

learning resources

1. Jaramaz S., Micković D.: Internal ballistics, Faculty of Mechanical Engineering, Belgrade, 2002

number of hours

total number of hours: 46
active teaching (theoretical)

lectures: 0

active teaching (practical)

auditory exercises: 0
laboratory exercises: 0
calculation tasks: 0
seminar works: 0
project design: 0
consultations: 0
discussion and workshop: 0
research: 0

knowledge checks

check and assessment of calculation tasks: 0
check and assessment of lab reports: 0
check and assessment of seminar works: 0
check and assessment of projects: 0
colloquium, with assessment: 0
test, with assessment: 0
final exam: 46

assessment of knowledge (maximum number of points - 100)

feedback during course study: 10
test/colloquium: 0
laboratory exercises: 20
calculation tasks: 0
seminar works: 40
project design: 0
final exam: 30
requirements to take the exam (number of points): 35

references