University of Belgrade

Faculty of Mechanical engineering

Course catalog

B.Sc. (undergraduate) academic studies

Belgrade
November, 2012

Table of contents

MFB

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 styding in Mechanical faculty from the point o view of pactical 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 styding 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 expereance in ambient similar to the ambient where the graduated student - mechanical engineer will realize his own proffesioanal carrier.
Recognizing the basic functioning of the bussines systems especially in domain of development, design and manufacturing of the mechanical systems.

learning outcomes

Students can reach practical expereances about the organization and functioning the bussines systems that deal in mechanical engineering. Student can be introdused in bussines comunication, 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 proffessor. Generally, student can realize practical work in: manufacturing companies, design companies, companies which worh 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

AERODYNAMIC CONSTRUCTIONS
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, ect.

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 sudent 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

Пractical 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, quizes 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 understending of aircraft and power systems if they are oriented to other aeronautical fields, or to further specialization in this aeria.

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

Theoretical lectures: Aircraft design procedures. Wing design characteristics. Design of tail surfaces. Fuselage design. Landing gear design. Application of modern aluminium alloys. Application of super-alloys. Connection of assembles and surface protection. Application of non-metallic materials in aeronautics. Jigs and fictures.
Work with surface modeling in CATIA. Aeronautical standards. Materials designation.
Heat treatment and surface protection. Composite materials. Documentation for composite materials. Ply and fabrics. Testing of composite materials. Tools for manufacturing aircraft parts. Heat treatment of composite materials. Tools for composite part production. Unidirectional composites. Rivet types and riveting. Tools for riveted structures.

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

Theory: Introduction – modern design methods – software tools and advanced analisys techniques application – mathematical basis - an algorithmic concept of the finite element method - basics of matrix algebra – numerical analysis methods - mathematical interpretation of the finite elements - linear element – surface elements – volume elements - the design, analysis and solving engineering problems using finite element method (line elements) - the design, analysis and solving engineering problems using finite element method (surface elements) - the design, analysis and solving engineering problems using finite element method (volume elements)

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, Strenght of material

learning resources

1. M. Kalajdžić, "Finite Element Method ", IAMA Belgrade 1978., KDA(in Serbian)
2. Additional materials (written excerpts with the lectures, setting tasks, guidelines for solving the task), DVL
3. M. Sekulović, "Metod konačnih elemenata", IRO "Građevinska knjiga", Beograd 1988
4. Z. Petković, "Metalne konstrukcije u mašinogradnji 2", Mašinski fakultet, Beograd, 2005.

5. O.C.Zienkiewicz, R.L.Taylor, J.Z.Zhu, "The Finite Element Method: Its Basis and Fundamentals Sixth Edition", Elsevier, 2005.
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
- Characteristics of composite materials. The characteristics of matrix and reinforcement (woven and continuous fibers). Characteristics of pre-preg materials. Specificity of sandwich constructions.
- 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

2. R.Jones,"Mechanics of Composite Materials, Second edition",Taylor and Francis,1999
3. A.Baker, S.Dutton,D.Kelly, "Composite Materials for Aircraft Structures, Second edition", AIAA,2004

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 exploatation in aeronautics.

learning outcomes

After completing the course, a student is familiar with the philosophy of design, manufacturing technologies and specifics of protection, exploatation 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
- Characteristics of composite materials. The characteristics of matrix and reinforcement (woven and continuous fibres). Characteristics of pre-preg materials. Specificity of sandwich constructions.
- 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

2. R.Jones,"Mechanics of Composite Materials, Second edition",Taylor and Francis,1999
3. A.Baker, S.Dutton,D.Kelly, "Composite Materials for Aircraft Structures, Second edition", AIAA,2004

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 learning 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

Introduction. General Settings in flight mechanics. Hiposonic, subsonic, transsonic, supersonic and hypersonic flight. Thrust. Level flight. Sailing. Flight mechanics of natural flyers. Performance of aircraft. Manoeuvering and aerobatic flying. Aircraft stability and control. Aircraft flight testing. Mechanics of cosmic flight.

practical teaching

The Atmosphere and the Air, International Standard Atmosphere, Wind Tunnels, Measurement of Air Speed, Airfoils - Subsonic Speeds, The Engine - Jet Propulsion - Engine and Propeller Propulsion. The Four Forces - Condition of Equilibrium. Maximum Endurance and Range. STOL and VTOL Aircraft. Taking-off and Landing. Turning - Angle of Bank - Aerobatics - Manoeuvrability. Longitudinal Stability - Lateral Stability - Directional Stability - Control. Hiposonic, subsonic, transsonic, supersonic and hypersonic flight. Ballistics and Astronautics. Escape from the Earth - Projectiles and Satellites. Going to the Moon. Orbiting the Moon - The Return Flight - Re-entry into the Atmosphere. Flights in Space - Aeroplane, Missile, Satellite. Examples of flying in nature.

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

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

A. C. KERMODE, Mechanics of Flight, 11th EDITION, Prentice Hill, England, 2006.

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 moder solution methods in stress analysis related to aircraft structures and their implentation in solving real structural problems.
2. introduction to experimantal stress analysis of aircraft structures.
3. introduction to thin-walled structures and composite meaterials.
4. introduction to computer modeling and simulation of aircraft structures

learning outcomes

1. mastering basic theoretical knowledge in structural analysis.
2. application of aquired 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 thoretical part following topics are covered: Ircraft loads, load coefficient, flight anvelpe, anvelope for symmetric flight cases, gust loads, unsymmetric loading condtitions, landing gear loads, engine mount loads and stress analysis, wing skin, sing skin buckling, normal and shear stress calculation, effective width, wing stress analysis, wing spar analysis , wing- fuselage rib connection analysis, design solutions, delta wing stress calculation, fuselage stress strain calculation methods, pressurized cabin calculation, stress analysis in the vicinity of openenings, fuselage rib calculation, finite element method applied to airframe structural analyisis, structure idealization, composite material stress calculation, ststic 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. Nmerical examples are analyzed. Practical student work is realized through mandatory exercises and desigh project realization using computer softwre 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
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 it's 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. konwledge of modern methodology approach to solve problems related to design and stress analysis of aircraft components

theoretical teaching

During theoretical part of the course, following topics are covered: Material and space coordinates. Equilibrium eqations. Compatibility conditions. Boundary conditions. Elastic behavior of materials. Plane strain. Plane stress state. Mathematical methods in solving these problems. Force method. Displacement method. Cross section warping. Exact solutions for axial, bending and torsion problems for loaded elastic bodies. Plates and Shells. Shear stress analysis. Composite Plates. Lamina and Laminate. Sandwich composite structures. Interlaminar stresses. Failure criteria applicable to composite materials. Variational methods. Method of virtual work. Potential energy minimum principle. Rayleigh -Ritz principle. Galerkin method. Colocation mathod. Finite elemnet method formulation. covergence conditions. Beam and rod finite element formulation. Stiffness matrix and equivalnet nodal force matrix.

practical teaching

During practical part of the course covered topis in theoretical part are demonstrated in practice. Typical practical problmes 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.
Martinov M. et al, My tractor, RES trade, Novi Sad, 2007 .
Tesic M., Principle of operation of machines for harvesting grass material, FTN, 1984.

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 .
Moser E.:Verfahrenstechnik Intensivkulturen,Verlag Paul Parey,Univerzitet Hohenhein,2005.,Nemacka
Getreideertne-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
Veselinov B., M Martinov., Bojic S., Machinery for biosystems, practical, FTN Novi Sad, 2009.

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 ssence and cooling methods. 10.0. The economy of thermo energy resources and thermo-tehnical 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

1. Topic M. Radivoj, Basics of design, calculation and construction of dryers, Scientific Books, 1989. Belgrade, KPN, 2. Topic M. Radivoj, Bogner Martin, Drying technique, Institute for

Textbooks and Teaching Aids, 2002., Belgrade KPN, 3. Laboratory installation to run labs, LPI; 4. Topic M. Radivoj, Drying and Hygrothermal processes (Handouts for lecture). Example of finished projects and term papers. Various guidelines and standards.

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 .A, (1950), Theory of Drying, "State Energy Publishing House", Moscow - Leningrad.
Lykov V. M (1970), Dying in the chemical industry, the publishing house, "Chemistry", Moscow.
Draganov, J. B. (1991). Course design for heat engineering and application of heat in agriculture, "Agropromizdat" Moscow.
Filonenko K. G., Grishin A, M. Goldenberg, M. J., (1971), Drying food plant materials, "Food Industry", Moscow.
Ginsburg, S. A (1973), Foundations of the theory and technique of drying foods, "Food Industry", 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

1. Markovic D: Transport in agriculture, MF, 1997.
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 Hohenhein,2005.,Nemacka
Karel M., Lund D. B., Physical principles of food preservation, Marcel Dekker inc., New York, 2003.
Heldman D. R., Handbook of food engineering, Taylor & Franncis Group, New York, 2007.
M. Veres. Basics of food preservation, Belgrade, 2004.

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

Markovic D.: Transport in Agriculture, Belgrade, 1997.

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 producion 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 saw dust. 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

1.Labudović Boris, Renewable Energy, Energy Marketing, 2002.KDA
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 M. E., (1946), Wind turbines, State energy publisher, Leningrad.
Duffy A. J., Beckman AW, (1977), Thermal Processes with use of solar energy , MIR, Moscow.
Knap V., Kulišić P., (1985), New sources of energy, School Book, Zagreb
Labudović B., (2002), Renewable Energy, Energy Marketing Ltd., Sokolska 25, 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.
Martinov M. et al, My tractor, RES trade, Novi Sad, 2007 .
Tesic M., Principle of operation of machines for harvesting grass material, FTN, 1984.

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

Personal computers in automatic control. Computer communications with peripheral devices. Basic functions of programming language C. main() function. Basic functions for communication with peripheral devices printf() and scanf(). Constants, variables and expressions. Preprocessor statements. Data types. Variables address. Pointers. Dereferencing of pointers. Program branching statements: conditional branching, comparison of expressions, statements if..else, switch, do...while. Structures and unions.
Variables,matrices and vectors in MATLAB. Manipulations of vectors and matrices. Vectors and matrices operations. Input and output files. Use of strings. While loop.Conditional branching if statement. Break and continue statement. Multiple branching, switch statement. Functional file. Return value of function. Inline statement. Function of function. Creating graphics. Graphical processing of the pictures. S-functions and simulation diagrams.

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

Hands out on: http://au.mas.bg.ac.yu/Nastava-Kau/Nastava_Download.htm
•PC computers, Computer laboratory, Faculty of Mechanical Engineering Belgrade

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

Brian W. Kernighan and Dennis M. Ritchie, “C Programming Language”, Second Edition, Prentice Hall, PTR, 1988.

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

Introduction to control systems with examples from practice. Digital computers in automatic control. Programmable logic controller (PLC). Implementation of digital computer in automatic control circuit. Pneumatic restrictions, hydraulic restrictions, bellows, membrannes and cylinders. Motion transducers: potentiometers, inductive and pneumatic with nozzle. Calibration and tuning. Pressure andflow transducers: orrifices, nozzles, differential pressure transducers, tuning callibration and commisioning. Temperature trabsducers: thermocouples, Pt 100 probes. Level transducers: electronic and pneumatic. Electronic digital controllers. Pneumoelectric actuators and motors: membranne actuators with positioners, cylinders controlled by valves. Hydroelectric final elements: hydraulic cylinders controlled by servovalves, hydraulic motors and pumps. Comiisioning, maintance and tuning.Electrical final elements: DC motors,AC motors,stepper motors,linear motors. Frequency converters, connection types tuning and commisioning. Compressed air sources. Hydraulic power supply systems. Electric power supplies.

practical teaching

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

-Practice with PLC. Example of SCADA system. Practice with Matlab/Simulink. Practice with potentiometric motion transducers. Transducers power supplies. Indication instruments. Practice with pressure transducers. Calibration and tuning.
Electric motors and frequency converters. Hydraulic cylinder with spool valve. Statical characteristics determination.

prerequisite

Basic principles of thermodynamics,fluid mechanics and physics.

learning resources

-Control systems hands-out on: http://au.mas.bg.ac.yu/Nastava-Kau/Nastava_Download.html

-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

Pneumoelectric Control Systems Z.Ribar. Faculty of mechanical Engineering. 1997.
HydraulicControl Systems. H.E.Merritt. 1967.
The Analysis and Design of Pneumatic Systems. B.Andersen.1967.

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 problem. Hale-s chart and Nichols diagram. Parametric plane methods. Structural synthesis and design. Regulator matching. Compensator design. Bode diagram . Root locus method. Performance index. Optimizations methods - elementary approach in parameter plane. 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.Debeljković, B.R.Milojković, “Linear System Design”, Faculty of Mechanical Engineering, Belgrade, 1981 ,Second ed .1987, pages 383.

D.Lj.Debeljković, “Linear System Design - Problems and Exercises”, Faculty of Mechanical Engineering, Belgrade, 1981, Second ed. 1988, pages 253.

D. Lj. Debeljkovic, “Control System Design: Conventional and Modern Approach ", Čigoja press, Belgrade, (in Serbian), 2008, pages 399.

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

D.Lj.Debeljković, B.R.Milojković, “Linear System Design”, Faculty of Mechanical Engineering, Belgrade, 1981 ,Second ed .1987, pages 383.
D.Lj.Debeljković, “Linear System Design - Problems and Exercises”, Faculty of Mechanical Engineering, Belgrade, 1981, Second ed. 1988, pages 253.
D. Lj. Debeljkovic, “Control System Design: Conventional and Modern Approach ", Čigoja press, Belgrade, (in Serbian), 2008, pages 399.

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 systema.
-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 forcontrol systems analisys and synthesis.
-Development of analythical and/or experimental methods of testing basic dynamic and static characteristics of control components andcontrol systems.

theoretical teaching

Introduction to control systems with examples from practice. Pneumatic restrictions, hydraulic restrictions, bellows, membrannes and cylinders. Motion transducers: potentiometers, inductive and pneumatic with nozzle. Calibration and tuning. Pressure andflow transducers: orrifices, nozzles, differential pressure transducers, tuning callibration and commisioning. Temperature trabsducers: thermocouples, Pt 100 probes. Level transducers: electronic and pneumatic. Electronic digital controllers. Pneumoelectric actuators and motors: membranne actuators with positioners, cylinders controlled by valves. Hydroelectric final elements: hydraulic cylinders controlled by servovalves, hydraulic motors and pumps. Comiisioning, maintance and tuning.Electrical final elements: DC motors,AC motors,stepper motors,linear motors. Frequency converters, connection types tuning and commisioning. Compressed air sources. Hydraulic power supply systems. Electric power supplies.

practical teaching

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

-Practice with potentiometric motion transducers. Transducers power supplies. Indication instruments. Practice with pressure transducers. Calibration and tuning.
Electric motors and frequency converters. Hydraulic cylinder with spool valve. Statical characteristics determination.

prerequisite

Basic principles of thermodynamics,fluid mechanics and physics.

learning resources

-Control systems hands-out on: http://au.mas.bg.ac.yu/Nastava-Kau/Nastava_Download.html

-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

Pneumoelectric Control Systems Z.Ribar. Faculty of mechanical Engineering. 1997.
HydraulicControl Systems. H.E.Merritt. 1967.
The Analysis and Design of Pneumatic Systems. B.Andersen.1967.

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
A. Paul Malvino, D. P. Leach, Digital principles and applications, McGraw-Hill, New York, 1975., KSJ, available in library of MEFB
K. L. Short, Microprocessors and programmed logic, Prentice-Hall, Englewood Cliffs, NJ, 1981., 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

Systematical fundaments of functioning nature, biological systems and technics. Biophysical fundaments of life, bioelements, biomolecules, systematic fundaments of cells functioning. Chemical and physical diagnostic parameters. Fundaments of biomedical measurements, diagnostic methods, and techniques in medicine. ECG apparatus, diagnostics and functioning. EEG apparatus, diagnostics and functioning. Ultrasound apparatus, diagnostics and functioning. NMR, diagnostics and functioning. Nanotechnologies in medicine.

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

Bronzino, J.D.: The Biomedical Engineering, Handbook, CRC Press - IEEE Press, Boca Raton, 1995.
Argenziano,G.,et al. Dermoscopy: An Interactive Atlas,Edra-MedicalPub.,Milan,2000.
Vo-Dinh,T., Biomedical Photonics, Handbook, CRC Press,Boca Raton, 2003.
Guyton A.C., Hall,J.E., Medical Physiology,Elsevier Inc, Philadelphia, 2006.

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

Michaels, D.D. Visual Optics and refraction, Grafomark, Beograd, 2000.
David A. Atchison: Optics of the human eye, Elsevier Health Sciences, April 2000.
Milojević Aleksandar: Talasna optika, Beograd, 1970.
Darko Vasiljević: Optički uređaji i optoelektronika, Book, 2005.
Jan Tuner, Lars Hode: Laser Therapy, Prima Books, 2005.

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

Theory: Human system, history of anatomy and physiology, basic concepts in anatomy and physiology. Embryology. Central nervous system. Locomotor system - muscular and skeletal system. Heart and blood flow. Respiratory system. Urinary system. Reproductive system. Skin. Eye and vision. Regulatory system: neural,immune and endocrine system.

practical teaching

prerequisite

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

learning resources

1. Written course material (handouts).
2. Jovanovic T., 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

Gerard J.Tortora., Ronald L. Evans. , Principles of human physiology, Harper & Row, New York , 1986
Waugh,A., Grant,A., Anatomy and Physiology,ChurcHill Livingstone, Ednburgh,2001.
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

Ljubomir Grujic, Dragan Lazic, "INTRODUCTION TO AUTOMATIC CONTROL", Script, Faculty of Mechanical Eng., 2007
Dragan V. Lazic, Milan R. Ristanovic, "INTRODUCTION TO AUTOMATIC CONTROL", Faculty of Mechanical Eng., 2005

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

Exams from the following subjects should be given:
All Mechanics, Thermodynamics and Fluid mechanics.

learning resources

D. Lj. Debeljkovic, G. V. Simeunovic, "Dynamics of Processes – Mathematical Model of Plants and Processes in Control Engineering", Faculty of Mechanical Engineering, Belgrade, 2006.

D. Lj. Debeljkovic, A. M. Sicovic G. V. Simeunovic, V. S. Mulic, Dynamics of Processes – Mathematical Model of Plants and Processes in Control Engineering, Part II Faculty of Mechanical Engineering, Belgrade, 2006.

D. Lj. Debeljkovic, D. T. Stojiljkovic, G. V. Simeunovic, A. M. Sicovic, V. S. Mulic, Dynamics of Processes – Mathematical Model of Plants and Processes in Control Engineering, Part IV – Dynamics of Large - Scale Industrial Plants and Processes, Faculty of Mechanical Engineering, Belgrade, 2008,
pp. 470.

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

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

references

D. Lj. Debeljkovic, G. V. Simeunovic, “Dynamics of Processes – Mathematical Model of Plants and Processes in Control Engineering”, Faculty of Mechanical Engineering, Belgrade, 2006.
D. Lj. Debeljkovic, A. M. Sicovic G. V. Simeunovic, V. S. Mulic, Dynamics of Processes – Modelibnfg of Plants and Processes in Control Engineering, Part II Faculty of Mech. Eng, 2006.

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 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 нonlinear problems and phenomena in the processes and plants, matematical description and analysis.
•Knowledge and understanding of фuzzy 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

Systems with manual semiautomatic and automatic control. basic representation of automatic control systems. Examples of various automatic control in mechanical engineering. Digital systems as base of digital technique: digital transmission of signals, number systems, binary logic, logic functions, logic circuits in digital computer (registers, counters, memmories), structure and architecture of digital control computer. Digital control of processes. Coordination of various parts of systems (A/D converters, D/A converters), various sensors and types of measurements. Processing of controlled signals. 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.

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 aquired knowledge, as well as to comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine aquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.

theoretical teaching

Introduction. Physical basic of welding. Conventional welding processes. Welding metallurgy of steel. Cracking in welded joints. Structural changes in welded joints. CCT diagrams and heat treatment of welded joints. Thermal processes in welding. Residual stresses and distortions in welds. The weldability and quality control of welded joints. Welding of various steel. Welding of non-ferous metals.

practical teaching

Symbolic representation of welds on drawings. Structural changes in welded joints. Weldability by calculation of the equivalent carbon content. Discontinuities in welded joints. Welding of alloyed steel. Calculation of chrome equivalent and nickel equivalent. Welding of certain non-ferous metals and iron. Surface welding, metallization, brazing and sticking. Special welding processes. Calculation of consumption of electrodes. Practice in the welding workshop. Equipment for arc welding processes. Equipment for resistance welding, gas welding and cutting. Consultations.

prerequisite

Engineering materials 1 and Engineering materials 2

learning resources

1. A Sedmak, V. Sijacki Zeravcic, A. Milosavljevic, V. Djordjevic, M. Vukicevic, Engineering materials, second part, Faculty of Mechanical Engineering, Belgrade, 2000.
2. V. Sijacki Zeravcic, A. Milosavljevic, A Sedmak, Manual for Engineering materials – Welding, Brazing and Casting, Faculty of Mechanical Engineering, Belgrade, 1996.

number of hours

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

K. Weman, Welding Procces Handbook, Woodhead Publishing Ltd, 2003.
G. Mathers, The welding of aluminium and its alloys, Woodhead Publishing Ltd, 2002.
D. Geary, Welding, The McGraw-Hill Companies, 2000.
S. Kou, Welding Metallurgy- second edition, John Wiley & Sons, 2003.

Combustion

ID: BSc-0730
teaching professor: Стојиљковић Д. Драгослава
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

Fundamentals of thermodynamics of the combustion process, general terms, material and energy balance of the process. Fundamentals of chemical statics and kinetics of thermal processes. Physical and physical-chemical phenomena in the combustion process. Specific features of combustion of solid, liquid and gaseous fuels. Combustion appliances. Environmental aspects of combustion.

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

Fundamentals of thermodynamics of the combustion process, general terms, material and energy balance of the process. Fundamentals of chemical statics and kinetics of thermal processes. Chemical equilibrium, the speed of chemical reactions. Physical and physical-chemical phenomena in the combustion process. The phenomena of ignition and self-ignition. Specific features of combustion of solid, liquid and gaseous fuels. Combustion appliances for different fuels. Environmental aspects of combustion. The causes, mechanisms of toxic components and the possibility of prevention. The measures and procedures for reduction of toxic emissions.

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 combbustion 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

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

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 aquired knowledge, as well as to comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine aquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.

theoretical teaching

Introduction. Conventional welding processes. Theory of electric arc. Welding power supply characteristics. Manual metal arc welding. Gas metal arc welding (MIG/MAG). Flux cored arc welding. Gas tungsten arc welding (TIG). Submerged arc welding. Resistance welding processes. Survey of other welding processes. Gas welding. Gas cutting. Other cutting processes.

practical teaching

Classification and designation of MMA electrodes. Calculation of consumption of electrodes for manual metal arc welding. Estimation of parameters for MIG/MAG process. Practice in the welding workshop. Equipment for arc welding processes. Equipment for resistance welding, gas welding and cutting. Consultations.

prerequisite

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

learning resources

1.A.Sedmak, V.Šijački-Žeravčić, A.Milosavljević, V.Đorđević, M.Vukićević, Engineering materials, Second part, Faculty of Mechanical Engineering, Belgrade, 2000.
2. R.Prokić-Cvetković, O.Popović, Welding and related processes, Serbian state publisher of textbooks, Belgrade, 2011
3.V.Šijački-Žeravčić, A.Milosavljević, A.Sedmak, Manual for engineering materials-welding, brazing and casting, Faculty of Mechanical Engineering, Belgrade,1996.

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

W. Galvery, F. Marlow, Welding essentials: Questions&Answers, Industrial Press Inc. , 2007.
S. Kou, Welding metalurgy, John Wiley&Sons, 2003.
S.Kalpakjian, S.R.Schmid, Manufacturing engineering and technology, Pearson Education, 2006.
K.Weman, Welding processes handbook, Woodhead Publishing Ltd, 2003.
D. Geary, Welding, McGraw-Hill, 2000.

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 exersizes, 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

Introduction. Theoretical basis of welded structures. Strength of materials basics. The basics of weld and structural design. Behaviour of welded structures at various types of loading. Design of welded structures in static loading conditions. Design of welded structures in dynamic (fatigue) loading conditions. Basics in testing and inspection of welded structures. Stress and strain states. Theoretical basics of Tensometry.

practical teaching

Static calculation and design of welded structures. Dynamic calculation and design of welded structures. Problem solving, examples, exercises. Application of standard codes for evaluating stress states at various loading types. Calculation of stress and strain states. Deformation and stress measurements. Tensometry and its application to welded structures. Examples of tensometric applications on welded structures with a retrospective view on some existing problems in practice.

prerequisite

Attended lectures and exercises: Strength of Materials, Mechanics, Resistance of Structures, Basics of Welding, and Engineering Materials 1 and 2.

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

O.W. Blodgett, Design of Welded Structures, Publ. The James F. Lincoln Arc Welding Foundation, 1966.
T. Lassen, N. Recho, Fatigue Life Analyses of Welded Structures, ISTE ltd., USA, 2006.
J. Hicks, Welded Joint Design, 3rd ed., Woodhead Publishing, UK, 1999.
M.B. Wong, Plastic Analysis and Design of Steel Structures, Elsevier, Amsterdam, 2009.
R. Blondeau (Ed.), Metallurgy and Mechanics of Welding - Processes and Industrial Applications, ISTE Ltd., John Wiley & Sons, Inc., 2008.

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

Introduction. Theoretical basics of welded structures. Fundamentals of strength of materials. Basics of weld design and construction. Behaviour of welded structures under different types of loads. Design of welded structures to static loads. Design of dynamically loaded welded structures. Theoretical basis of the trial of welded structures. Stress and strain state. Theoretical basis of tensiometry. Application of tensiometry on the welded structures.

practical teaching

Static analysis of welded structures. Dynamic analysis of welded structures. Application of standards on calculating welded structures under different types of loads. Calculation of stress and strain condition. Measuring of strains and stresses. Tensiometry and its application to welded structures.

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 aquired knowledge, as well as to comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine aquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.

theoretical teaching

Introduction. Engineering materials. Basic types of materials: metals, ceramics and glass, polymers. Composites. Properties of materials: chemical, physical (electrical, magnetic, optical), mechanical. Production of materials - general terms. Basic principles of material selection. Types of bonds: metallic, ionic, covalent. Van de Walls and their characteristics. Crystal and amorphous structures. Melting temperature. Softening. Crystal structure of metals. Types of crystal lattice. Faults in crystal structure: spot errors – voids, linear faults – dislocations, surface faults grain and subgrain boundaries, volume faults – cavities. Importance of erros and their influence on the material properties. Plastic deformation. Diffusion. Basic features of fracture. Theoretical and real cohesion strengths of metallic materials. Basic feature of of fracture mechanics. Fracture toughness. Transition temperature. Types of fracture. Ductile and brittle fracture. Basic features of alloying. Pure metals. Solid state solutions. Interstitial and solid state solutions – substitution. Intermediate compounds. Eutectic reaction. Cooling curves. Properties. Basic types of state diagrams.

practical teaching

Single cell. Miller plane and direction indices. Structure of ceramics, polymers. Materials behaviour under mechanical stresses. Stress - deformation: metals, ceramics, polymers. Elastic deformation. Plastic deformation. Tensile and compression testing. Elastic modulus. Hardness, static and dynamic methods- short overview of testing methods. Toughness, impact testing. Fatigue. Creep. Technological testing. Non-destructive testing. Phase diagrams of alloys with complete solid state solubility. Phase diagrams of alloys with solid state insolubility. Phase diagrams of alloys with partial solid state solubility. Properties. Applications.

prerequisite

Defined by subject curiculum.

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

W. Callister, Materials Science and Engineering, John Wiley & Sons, Inc., 2007.

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 aquired knowledge, as well as to comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine aquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.

theoretical teaching

Metastable and stable phase diagrams of Fe - C. Steel and types of steel. Cast irons. Heat treatment of steel - annealing, quenching and tempering. Case hardening treatments: carburization, nitriding, carbonitriding, diffusion metalization. Non-ferrous alloys − aluminium, its alloys and their heat treatment. Nickel based alloys. Titanium based alloys. Hardfacing alloys. Composite materials. Introduction to welding. Electric arc. Arc welding. Gas metal arc welding (MIG - Metal Inert Gas), shielded metal arc welding (SMAW/MAG − Metal Active Gas), gas tungsten arc welding (TIG − Tungsten Inert Gas), submerged arc welding. Oxyfuel welding and cutting. Resistance welding.

practical teaching

Cooling curve. Determination of the composition and fraction of the phases (lever rule). IC and KC diagrams and their application. Aloyed steels. Light microscopy and misrostructure. Heat treatment of steel. Steel marking. Material defects and their identification. Hardenability. Jominy end-quench method. Heat treatment of aluminium alloys-quenching and ageing. Mechanical testing od welded joints. Preparation of materials for welding. Technic and technology of arc welding. Technics and technologies of inert gas metal arc welding, shielded metal arc welding, inert gas tungsten arc welding, submerged arc welding. Technics and technologies of oxifuel welding and cutting. Resistance welding and methods. Welding Lab exercises-electric arc welding, oxyfuel welding and cutting, resistance welding. Tests and Office hours.

prerequisite

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

learning resources

1. A.Sedmak, V. Šijački Žeravčić, A. Milosavljević, V. Đorđević, M. Vukićević, Mašinski materijali, drugi deo, Mašinski fakultet, Beograd, 2000
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

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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 appearence 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 collabortions 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

Corosion aspects of metal biomaterials, types of corosion, corosion process as a response of the biomaterial to the organic enviroment. Electrochemical aspects of biomaterial. Purbe's diagrams of metal biomaterials. Ceramic biomaterial parts/prothesis manufacturing technique. Biodegradable polymer materials, types, properties and their behavior in a living organism. Predictions of the properties of composite materials. Degradation of biomaterials, types of damage due to wear, fatigue and stress corosion and their failure with potentialy accompanying consequences onto the living organism. Control methods for different biomaterials. Biomaterial fatigue. Biomaterials for medication and gene transport. Choosing biomaterial for hip replacement.

prerequisite

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

learning resources

1. R.W.Cahn, et all, Physical Metallurgy, Vol.I&II, 1996, Elsevier Science, KCJ
2. M. Elices, et all, Fiber fracture, 2002, Elsevier Science, KCJ
3. T. D. Burchell, Carbon materials for advanced technologies, 1999, Pergamon, Elsevier Science, KCJ
4. R. Brundle, et all, Encyclopedia of materials characterization-Surfaces, Interfaces, Thin Films, 2002, Butterworth-Heinemann, Manning Greenwich, KCJ
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

B. Ratner, A. Hoffman, B. Schoen, J. Lemons, An Introduction of Materials in Medicine, Academic Press 2004
K. Katti, Biomaterials in total joint replacement, J. Colloids and surfaces B, biointerfaces 39(2004)133-142
J. Lemons, Ceramics: Past, present, future, Bone 19 No1(1996) 121S-128S
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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.
2. A. Rac, Fundamentals of Tribology, Faculty of Mechanical Engineering, Belgrade, 1991, (in Serbian).
3. A. Rac, A. Vencl, Sliding Bearing Metallic Materials – Mechanical and Tribological Properties, Faculty of Mechanical Engineering, Belgrade, 2004, (in Serbian).
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

B. Ivković, A. Rac, Tribology, Yugoslav Tribology Society, Kragujevac, 1995 (in Serbian).
J. Halling, Principles of Tribology, The MacMillan Press Ltd., London, 1975.
D.F. Moore, Principles and Applications of Tribology, Pergamon Press, Oxford, 1975.
B. Bhushan, Principles and Applications of Tribology, John Wiley & Sons, New York, 1999.

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

Fuel types. Stoichiometric combustion equations. Combustion temperature. Lubricating materials, the basic phenomena of friction and wear, division of lubricants and their properties. Industrial water, types and properties. Fundamentals of thermodynamics of the combustion process, general terms, material and energy balance of the process. Fundamentals of chemical statics and kinetics of thermal processes. Physical and physical-chemical phenomena in the combustion process. Environmental aspects of combustion.

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

Fuel and combustion basics. The quantity and composition of combustion products. Combustion temperature. Lubricating materials: basic phenomena of friction and wear, the types of lubricating materials and their properties. Industrial water: water types and basic properties. Fundamentals of thermodynamics of the combustion process, general terms, material and energy balance processes. Fundamentals of chemical statics and kinetics of thermal processes. Chemical equilibrium, the speed of chemical reactions. Physical and physical-chemical phenomena in the combustion process. Specific features of combustion of solid, liquid and gaseous fuels. Environmental aspects of combustion. The causes, mechanisms of toxic components and the possibilities for prevention.

practical teaching

Calculation of heating value of fuel. Elements of stoichiometry. Combustion temperature. Determining the characteristics of proximate analysis of solid fuels. Determination of the heating value of solid and liquid fuels with a bomb calorimeter and the determination of heating value of gaseous and liquid fuels with Junkers calorimeter. Determination of the distillation curve. The significance of the main temperatures on the distillation curve. Characteristics of fuels and lubricants at elevated and low temperatures. Quality control. Determination of the viscosity of liquid fuels and lubricants (dynamic, kinematic viscosity and relative). Determination of penetration of lubricating greases. Determination of water hardness and acidity. Dissociation products of combustion. Determination of the dissociation temperature of combustion. Incomplete combustion. Length of the laminar flame. The boundaries of stable combustion. Ignition limits (concentrations). Flame front propagation speed.

prerequisite

No special requirements.

learning resources

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

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

Fuel types. Stoichiometric combustion equations. Combustion temperature. Characterization of solid fuels, proximate and elemental analysis. Solid fuel origins, derivation, applications. Liquid fuels, origins, derivation, applications. Gaseous fuels, origins, derivation, applications. Industrial water, types and properties. Essential characteristics of the water for use in industrial purposes. Problems in the use of natural waters. Water treatment for industrial applications.

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

Fuel and combustion basics. The quantity and composition of combustion products. Combustion temperature. Solid fuels, origins, procedures for derivation and application. Liquid fuels, origins, procedures for derivation and application. Gaseous fuels, origins, procedures for derivation and application. Industrial water: water types and basic characteristics. Preparation of water for use for industrial purposes.

practical teaching

The conversion from one to another mass of solid fuel. Calculation of heating value of fuel. Elements of stoichiometry. Combustion temperature. Determination of the characteristics of proximate analysis of solid fuels. Determination of the heating value of solid and liquid fuels with a bomb calorimeter and the determination of the heating value of gaseous and liquid fuels with Junkers calorimeter. Determination of the distillation curve. The significance of the main temperature on distillation curve. Characteristics of fuels at elevated and reduced temperatures. Quality control. Determination of the viscosity of liquid fuels and lubricants (dynamic, kinematic viscosity and relative). Determination of water hardness and acidity.

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

Fuel types. Stoichiometric combustion equations. Combustion temperature. Characterization of solid fuels, proximate and elemental analysis. Solid fuel origins, derivation, applications. Liquid fuels, origins, derivation, applications. Gaseous fuels, origins, derivation, applications. Lubricants, types and main characteristics, derivation, applications. Industrial water, types and properties. Essential characteristics of the water for use in industrial purposes. Problems in the use of natural waters. Water treatment for industrial applications.

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

Fuel and combustion basics. The quantity and composition of combustion products. Combustion temperature. Solid fuels, origins, procedures for derivation and application. Liquid fuels, origins, procedures for derivation and application. Gaseous fuels, origins, procedures for derivation and application. Lubricants: lubricants types, main characteristics relevant for application, the application of lubricants. Industrial water: water types and basic characteristics. Preparation of water for use for industrial purposes.

practical teaching

The conversion from one to another mass of solid fuel. Calculation of heating value of fuel. Elements of stoichiometry. Combustion temperature. Determination of the characteristics of proximate analysis of solid fuels. Determination of the heating value of solid and liquid fuels with a bomb calorimeter and the determination of the heating value of gaseous and liquid fuels with Junkers calorimeter. Determination of the distillation curve. The significance of the main temperature on distillation curve. Characteristics of fuels at elevated and reduced temperatures. Quality control. Determination of the viscosity of liquid fuels and lubricants (dynamic, kinematic viscosity and relative). Determination of the basic characteristics of grease. Determination of water hardness and acidity.

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 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)
[2] Plavšić N., Šijački-Žeravčić V., Stamenić Z.: Tables of mechanical materials, profiles, sheets and wires, Faculty of Mechanical Engineering, Belgrade, 2004;
[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

Introduction, importance and the domain or reparation application. Causes of damage and destruction of machine parts and constructions. Reparation technology. Reparation of gears, bearing and shafts. Reparation by repair welding i thermal spraying. Reparation of welded constructions. Reparation of axles. Tools reparation. Reparation of pressure vessels. Reparation of equipment and parts of thermoenegetical facilities. Equipment and reparation materials.

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

1. A.Sedmak, V. Šijački Žeravčić, A. Milosavljević, V. Đorđević, M. Vukićević, Mašinski materijali, drugi deo, Mašinski fakultet, Beograd, 2000.
2. V. Šijački Žeravčić, A. Milosavljević, A. Sedmak, Priručnik za mašinske materijale-zavarivanje, lemljenje i livenje.
3. Ognjanović M.: "Mašinski elementi", Mašinski fakultet, Beograd, 2007;
4. Plavšić N., Šijački-Žeravčić V., Stamenić Z.: Tablice mašinskih materijala, profila, limova i žica, Mašinski fakultet, Beograd, 2004;

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
I. Hrivnjak, Zavarljivost čelika, Serbian translation (Lj. Nedeljković), Građevinska knjiga, Beograd, 1982
Krsmanović V., Mitrović R., Klizni i kotrljajni ležaji, Mašinski fakultet, Beograd, 2004
M.Ristivojević, Zupčanici-1 Kinematika i kontrola, Zavod za udžbenike i nastavna sredstva Beograd, Beograd, 2005
/

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.
2. A. Rac, Fundamentals of Tribology, Faculty of Mechanical Engineering, Belgrade, 1991, (in Serbian).
3. A. Rac, Lubricants and Machine Lubrications, Faculty of Mechanical Engineering, Belgrade, 2007, (in Serbian).
4. A. Rac, A. Vencl, Sliding Bearing Metallic Materials – Mechanical and Tribological Properties, Faculty of Mechanical Engineering, Belgrade, 2004, (in Serbian).
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

B. Ivković, A. Rac, Tribology, Yugoslav Tribology Society, Kragujevac, 1995 (in Serbian).
J. Halling, Principles of Tribology, The MacMillan Press Ltd., London, 1975.
D.F. Moore, Principles and Applications of Tribology, Pergamon Press, Oxford, 1975.
B. Bhushan, Principles and Applications of Tribology, John Wiley & Sons, New York, 1999.
A.R. Lansdown, Lubrication – A Practical Guide to Lubricant Selection, Pergamon Press, Oxford, 1982.

Tribotechnique

ID: BSc-0371
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:
• 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.
2. A. Rac, Lubricants and Machine Lubrications, Faculty of Mechanical Engineering, Belgrade, 2007, (in Serbian).
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

B. Jeremić, Technology of Technical Systems Maintenance, ESKOD, Kragujevac, 1992, (in Serbian).
--, Handbook of Loss Prevention, Springer-Verlag, Berlin, 1978.
R.A. Collacott, Mechanical Fault Diagnosis, Chapman and Hall, London, 1977.
H.E. Boyer (Ed.), Metals Handbook – Failure Analysis and Prevention, American Society for Metals, Metals Park, 1975.
A.R. Lansdown, Lubrication – A Practical Guide to Lubricant Selection, Pergamon Press, Oxford, 1982.

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

Fundamental phenomena in fluid mechanics. Physical properties of fluids. State of stress in fluids. Resulting surface force vector. Fluid statics. Conservation laws - equations of motion. Conservation of mass - continuity equation. Conservation of momentum - momentum equation. Euler equation. Bernoulli integral of Euler equation for steady and unsteady flow. Bernoulli equation and applications. Conservation of energy - energy equation. Energy equation for steady, one-dimensional flow. Basics of compressible flows. Viscous fluid and state of stress in viscous fluid. Effects of viscosity, shear stresses and non-dimensional numbers in fluid mechanics. Momentum and momentum of momentum law and applications. Laminar and turbulent flow regime. Velocity profiles and pressure drop in circular pipe in laminar and turbulent flows. Nikuradse-Moody chart. Bernoulli equation for viscous flows. Hydraulic calculation of simple and complex pipe networks. Basics of boundary later and wakes. Navier-Stokes equation and some special solutions. Dimensional analysis and similarity theory.

practical teaching

Determination of stress distribution and state of stress in fluid. Fluid statics. Absolute and relative (gage) pressure. Distribution of pressure in fluid statics. Calculation of pressure forces on flat and curved surfaces. Distribution of pressure in air in Earth's atmosphere. Standard atmosphere. Calculation of volume and mass flow rate. Bernoulli equation. Basic problems in compressible flows. Application of momentum and momentum of momentum equation for solution of practical problems. Flow of liquids in pipes. Hydraulic calculation of simple and complex pipe networks. Basic examples from dimensional analysis and calculation of drag force on moving body. Determination of flow rate, friction coefficient and local resistances in exercises in laboratory.

prerequisite

Passed exams in following courses: Mathematics 1, Mathematics 2, Mathematics 3, Mechanics 1, Mechanics 2 and Mechanics3

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

Introduction to oil hydraulics. Application of oil hydraulic. Basic equations. Equations for calculations stationary regimes of oil hydraulic systems. Bernoulli's equation. Equation of continuity. Equations of linear and rotary movement. Energy balance and efficiency of oil hydraulic system. Pump aggregate and executive bodies. Oil hydraulics pumps and hydro-motors. Oil hydraulic working cylinders. Oil hydraulic distributors and regulatory components. Hydraulic batteries. Oil seating and oil transport. Introduction to pneumatics. Calculation of basic flow processes. Air flow in pipes and local resistance. Isothermal flow of gas in pipes. Elements of pneumatic system.

practical teaching

Hydro-pneumatics static. Calculation pressure forces in which working fluid acting on hydraulic and pneumatic components. Dependence of viscosity by temperature. Changing the oil temperature during operation oil hydraulic system (OHS). Calculation of closed oil hydraulic circuit (OHC) in stationary operating mode. Efficiency of pump and hydro-motor. Calculation of open (OHC) in stationary operating mode. Forces on hydro-cylinder. Hydraulic brake piston. Calculation of connecting rod on deflection. Calculation of (OHS) with two or more executive bodies. Efficiency of (OHS). Thermophysical properties of air. Calculation of separate condensate. Theoretical compressors. Air emphasis from reservoir of unlimited volume. Discharging of pneumatical chamber limited capacity. Calculation of isothermal air flow through the pipe. Approximate method for calculating air flow in pipe. Calculation of cylinder air charge that flows in through the long pipeline. Flow through one pressure differential device and through pressure differential devices connected in series.

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

Fundamentals of machine design

ID: BSc-0423
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

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

Janković, M.: Machine elements, first part, Belgrade, 2012.
Veriga, S.: Machine elements, 1. volumes - the general part, FME, 2006, KDA, bibl. FME, in serbian
Vitas D.: Fundamentals of mechanical structures design, I and II, Scientific Book, Belgrade, 1984, KDA, bibl. FME, in serbian.
Orlov, P.I.: Fundamentals of machine design, Parts 1, 2, 3, 4, MIR Publisher, Moscow, 1976 - 77, in english,.
Pahl, G., Beitz, W.: Konstruktionslehre, Grundlagen erfolgreicher Produktentwicklung, Methoden und Anwendung, 6. Auflage, Springer, 2005, in german..

Fundamentals of machine design

ID: BSc-0643
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

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

Ognjanović M.: Machine design, Faculty of Mechanical Engineering, Belgrade, 2000.
Orlov P.: Fundamentals of Machine Design, MIR Publishers - Moscow, 1980.
S.Veriga: Machine elements 1, Faculty of Mechanical Engineering, Belgrade
Fundamentals of design - a collection of solved calculated problems, MFB, 1999, ZZD, bibl. 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 copping 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 sucsessful 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

Attended subjects: Material strength, Machine elements-1. Favorable passhed Machine elements-1 and Machine elements-2.

learning resources

1.Ognjanović M.: Development and Design of machinery (theory, data, made examples) - Faculty of Mechanical Engineering Belgrade 2007., - KPN, MFB bookstore.

2.Electronic materials: hand outs, 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

Machine elements: definition and classification. Linear size dimensions tolerance. Machine parts form, orientation, location and run out tolerances. Surface roughness tolerance. Stress concentration and critical (ultimate) stresses of machine parts. Types of machine part failures, fatigue and dynamic strength (endurance limit). Safety factor, design available stress, caring capacity of machine part. Failure of machine part surfaces, service stress and critical stress in machine part surface layer. Shafts, axles and pins: function, design forms, application. Shaft and axle loads, stresses, dynamic strength (endurance limits) and safety factor. Shaft stiffness. Shaft and hub connections: friction connections, key connections, spline connections. Rolling bearings (the function and application): types and characteristics of standard roller bearings. Bearing load - the equivalent load. Failures and service life roller bearings. The selection and building in of roller bearings. Plain bearings: the function, characteristics, classification. Caring capacity of plane bearings without and with hydrodynamic lubrication. Heating, cooling and lubrication of sliding bearings. Design solutions, materials and shapes sliding bearing parts. Sealing of bearings. Thread and bolted threaded connections: the function, characteristics, classification. Screw bolted joints: longitudinally and transversely loaded (characteristics, classification, loading, clamping, strain, safety factors). Power screw assemblies.

practical teaching

Selection of linear size dimension tolerance. Analysis of clearance, interference and uncertain fits. Determination and calculation of stress concentration factors. Determination of machine parts dynamic strength (endurance). Calculation of safety factors of machine part. Load scheme of the shaft identification. Loads and stresses of the shaft calculation. Determining of shaft dimensions and safety factor. Calculation of the shaft and hub connections. Determine of rolling bearing caring capacity and service life. The selection and building in of rolling bearings.

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
- Plavsic N., M Ristivojević., R Mitrovic., B Rosić., Jankovic M., P Obradovic.: Machine elements - a manual for the exercises - Faculty of Mechanical Engineering Belgrade 2006.;
- Plavsic N., M Ristivojević., R Mitrovic., B Rosić., Jankovic M., P Obradovic.: Machine elements - collection of solved test tasks - Faculty of Mechanical Engineering Belgrade 2000.

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

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 2006-2011
Матек 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
- Plavsic N., M Ristivojević., R Mitrovic., B Rosić., Jankovic M., P Obradovic.: Machine elements - a manual for the exercises - Faculty of Mechanical Engineering Belgrade 2006.;
- Plavsic N., M Ristivojević., R Mitrovic., B Rosić., Jankovic M., P Obradovic.: Machine elements - collection of solved test tasks - Faculty of Mechanical Engineering Belgrade 2000.

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
Матек 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 мaterials, 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

Niemann, G., Winter, H., Höhn, B.R.: Mashinenelemente,, Berlin, Heidelberg, New York, 2001.
Shigley, J.: Machine Design, 3. Edition, 2012,
Norton, R.: Machine Design, 3. Edition, 2011,
Orlov, P. I.: Fundamentals of Machine Design, Part 1, 2, 3, 4, MIR Publishers, Moscow, 1986

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

A general view and basic terms (operational ability and its criteria, load, stress state, ultimate stress, safety factor, service life and reliability). Tribological aspects of machine elements design and operation. Failure analysis procedure. Diagnostic methods and means. Examples of geometric modelling, simulation and finite elements method used for machine elements failures analysis. Failures of shafts and axels, journal and rolling bearings, fasteners, gears and other machine elements and parts. Content of report on analyzed machine element failure. Basics of FMEA – failure modes and effects analysis for machine sistems.

practical teaching

Practical examples of machine elements operational ability assessment based on appropriate criteria. Determination of ultimate stress, safety factor, service life and reliability. Creating of machine elements failure analysis algorithm. Application examples of diagnostic methods and measurement techniques. Recognizing of different types of machine elements failures and identification of their causes. Machine elements failure analysis in concrete cases from engineering practice. Creating of report on carried out failure analysis.

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

Introduction with the basic concepts and goals of the course. Importance, types and test conditions. Testing methodology. Standards and regulations connected with tests. Determination of static characteristics of mechanical parts based on static characteristics of the standard model - specimens. Testing under dynamic conditions at a constant amplitude. Testing under dynamic conditions with varying amplitudes. Measuring stress and strain. Strain gauges. Stress spectrum. Rating working modes based on the results. Determination the working strength of machine parts. The probability of destruction. Determining the service life of machine parts using the hypothesis of linear accumulation of damage. Testing: axles, shafts, bearings and roller bearing, screws, springs, gear pairs. Testing of mechanical constructions and structures.

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

Ristivojević Mileta, Ristivojević Milisav: Machine construction testing, Zavod za udžbenike, Beograd, 2007.
Brčić V., Čukić R.: Experimental methods in designing of structures, Građevinska knjiga, Beograd, 1988.
Josifović Danica: Machine construction testing, Mašinski fakultet, Kragujevac, 2000.
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 o 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 цонтаинс 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

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

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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

Introduction, on the course and shape modeling (concept model, role models, use of models). Modeling tools, for software and their characteristics. Principles and method of modeling the form. Surface modeling, surface models. Modeling geometric body (Boolean operations). Additional tools for modeling shapes in CATIA V5. Parametric modeling, role and importance of parametric approach. Principles of modeling components. Modeling shape and production of technical documentation. Advanced tools and commands in the modeling using CATIA V5. Further application forms and components modeled in the simulation and analysis.

practical teaching

Introductory class. The concept of using CATIA V5 software. The content of the program and the general settings of CATIA V5. Drawing projection and profile (Sketch). Body Modeling (Part Design), the basic principles and advanced commands. Shape modeling (Shape Design), it advantages and disadvantages. Defining relationships between the parameters of the modeled shape. Fundamentals of modeling assemblies (Assembly Design). Modeling circuits of varying complexity (Assembly Design). Obtaining drawings and preparation of technical documentation (drafting). Advanced tools and commands, special modules in CATIA V5. Introduction to analysis and simulation of components and assemblies.

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 hydraukic 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

Krsmanovic Lj., Gajic A., Turbomachinery - Theoretical Basis, Faculty of Mechanical Engineering, Belgrade 2005.
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 thir regulation. Knowledge of the pump cavitation characteristics and operating characteristics change for fans working with density other than air.

theoretical teaching

Description of pumps and fans (PF). Energy balance. Definition of the internal work, impeller work and useful work. Flow work per unit - the head. Determination of the head by definition and along the pipeline route. Euler equation for turbomachinery. The impact of the impeller outlet angle on the impeller head and on the reaction factor. Impeller head reduction - the impact of a finite number of blades. Powers and efficiencies of PF. The laws of similarity. Characteristic ceofficients of PF. Classification of PF by types. Cavitation. Cavitation reserve. The cavitation coefficient. Suction head determination. The influence of fluid properties on the characteristics of PF - the impact of fluid viscosity on pump performance, and the influence of gas density on the characteristics of the fan. The calculation of basic dimensions of PF. Matching of PF performance curves with installation characteristics and regulation of PF. Selection of PF. Testings of PF. Application of PF in various plants. Piston pumps - description, classification, and the working principle. Nonuniformity of flow rate. Indicator diagram. Determination of power and suction height. Description of the rotating-piston pumps.

practical teaching

Calculation examples of the lectured material: The energy balance. Determination of head by definition and along the pipeline route. Euler equations for turbomachines. Impeller head reduction. Powers and efficiencies of PF. The laws of similarity. Characteristic coefficients of PV. Cavitation reserve. Suction head determination. PF matching and regulation. PF in various plants. Piston pumps - principles of work. Demonstrative laboratory exercises: Institute (laboratory) for hydraulic machinery - showing PF constructions and description of the role of individual parts. PF installations and description of their work.

prerequisite

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

learning resources

Textbook: Protic Z, Nedeljkovic M. Pumps and fans. Problems, solutions, theory, 6th ed.
Faculty of Mechanical Engineering University of Belgrade, Belgrade 2010.
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 Processess
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

Physical, financial and intangible forms of business resources. Profit and other goals of business. Concept, essence and types of entrepreneurship and entrepreneurs. Entrepreneurship and management. The management process. Entrepreneurship strategies. Business environment analysis. Individual, corporate and group entrepreneurship. Start-up firms. Net-entrepreneurship and e-business. Vision, mission, goals, strategy and tactics of company. Risk management in business. Financial aspects of business. Business plan as basic business tool. Social responsibility and business ethics. Decision-making in management and support systems. Interpersonal relations, groups and conflicts in company. Communications in organization. Methods of business negotiation. Control as phase of management process. Ecology management. Globalization and entrepreneurship.

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
John Jestom and Johan Nelis, Business Process Management: Practical Guidelines to Successful Implementations, Butterworth-Heinemann, 2006

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 approch, 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

Business system, production system, business-production system. Concept and types of information systems. Elements of information theory, concept and definition of information, entropy and information transfer. Pyradmidal information system. Data design. Notation system. Database design, database basic properties. Data warehouse. Integrated information systems in enterprises. Design of information systems in enterprises. Methodologies of information systems design. Structural system analysis (SSA). Information systems development. Non-automated information systems. Decision-making support systems. Artificial intelligence and expert systems. Hybrid systems. MRP system. CIM systems.

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.
V.Milacic, Z.Spasic, Computer-integrated technological systems CIM systems, FME, Belgrade, /In Serbian/ 1990.
D.D.Milanovic, D.Tadic, M.Misita, Management information systems, with examples, FME, Belgrade, /In Serbian/ 2005.

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

Analysis of functions: supply and demand, revenue and costs, production function; analyzing of elasticity, marginality and the average of these economic categories. Linear and nonlinear regression: characteristics and assumptions of regression model, method of least squares, characteristics of assessment, inference and prediction in a simple linear regression model, models of nonlinear regression analysis. Multiple regression analysis: method of least squares in multiple linear regression model, measures of representativeness in the multiple regression, inference in multiple linear regression model. Time series analysis: trend component, cyclical, seasonal and residual component. The optimal volume of production - profitability interval, an interval of profitability. System of demand function.

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);
Gujarati D: Basic Econometrics, McGraw-Hill,Inc.,New Yourk, 1995.
Maddala G S: Introduction to Econometric, John Wiley & Sons, 2002.

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

1. D. Kostić, Engineering English, Faculty of Mechanical Engineering, Belgrade, 2007.
2. A. J. Thomson, A.V. Martinet, A Practical English Grammar, Oxford University Press, Oxford, 1986.

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

M. Ibbotson, Cambridge English for Engineering, Cambridge University Press, Cambridge, 2008.
E.H. Glendinning, N. Glendinning. Oxford English for Electrical and Mechanical Engineering, Oxford University Press, Oxford, 1996.

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

1. D. Kostić, Engineering English, Faculty of Mechanical Engineering, Belgrade, 2007.
2. A.J. Thomson, A.V. Martinet, A Practical English Grammar, Oxford University Press, Oxford, 1986.

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

M. Ibbotson, Cambridge English for Engineering, Cambridge University Press, Cambridge, 2008.
E.H. Glendinning, N. Glendinning. Oxford English for Electrical and Mechanical Engineering, Oxford University Press, Oxford, 1996.

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

Society and his theoretical explanations. Sociological methods. Classification of sociological theories. Structure of society. Stratification. Sociological aspects of entrepreneurship and management. Social role and status. Social groups. State and govern of society. Political parties and social movement. Gender. Ethics. Religion. Massmedia.Education, science, innovation, culture and society, deviance and norms. Organized crime, social change and collective behavior. Fundamentals of economics: micro and macroeconomics. Production and resources. Market and demand. Cost, prices and incomes. Production function. Production costs. International economic relationship. Concept of sustainable development. Technological change, transition and globalization.

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 adreses, other literature according to the professor's recommendation, especially for seminar works presentations are important.

Slobodan Pokrajac, Fundamentals of Sociology, (in Serbian), Mašinski fakultet, Beograd, 2011
Slobodan Pokrajac, Nikola Dondur, Introduction to Economics, (in Serbian), Proleter, Bečej, 2009
Slobodan Pokrajac, Small Sociological Dictionary, (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

Entoni Gidens, Sociology, (in Serbian), Ekonomski fakultet, Beograd, 2003

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

Product range and type of production in the obeserved enterprises. The recording and analysis of existing organizational structure. Analysis of influential factors on the design of the organizational structure. Selection of the optimal strategy for solving structural, managerial and functional problems in the company. Overview and analysis of the methods for planning and monitoring of production. The proposal for the introduction of new methods for planning and monitoring of production. Monitoring and analysis of temporal structure of the production cycle. The monitoring and analysis of the layout of machines and jobs. The monitoring and analysis of transport flows, material and stock handling in the enterprise. Organization arrangements for the production by tools. Planning and tools providing for production. Level of JUS ISO 9000 implementation. Documentation of quality system. Generating solutions of the organizational structure.

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

Introduction to industrial ergonomics. Defining of a system and the man - machine system. System reliability and reliability of a man. Basic visual function and vision. Legibility, visibility and readability of alphanumeric information. Controls. Fundamentals of the engineering anthropometry. Biomechanics of movement, types and ranges of motion. Energy of work and fatigue. Receiving and processing of information. Nature and effects of noise. Vibrations, impact on the human body and work ability. Movement, acceleration and deceleration, effects on the body. Basics of computer interface. Presentation of ergonomic software packages. Examples from practice - ergonomics of packaging. Ergonomic methods. Ergonomic checklists. Assessment of usability of software and web presentations.

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

Handbook of human factors and ergonomics in consumer product design: uses and applications, 2011, Edited by Karwowski W., Soares M. and Stanton N., Taylor & Francis, London.

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 understansing 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

Basic concepts of indiatrial engineering. Presentation of classical, neoclassical, modern theories of organization. Management systems. Role of products, organization of product development, models of product accelerated development with computer support. Production program design. Methodology of planning business-production resources. Technique of network planning. Production capacities, categories of machinery capapcities. Method of instant perception. Linear programming. Organization of production preparation. Operational planning and termination of production. Direct preparation of production with its monitoring and regulation. Industrial logistics. Production documentation. Terotechnology. Maintenance systems. Information systems for maintenance needs. Indicators of business and production results. Studying and measuring of labor. Industrial ergonomics. Application of quality system in enterprises. Quality control. Application of information systems in business-production systems.

practical teaching

Exercises are realized through carrying out a project task that consists of three parts. Prior to assigninig 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 focuces 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 qaulity 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

Significance, organization parameters and structure of maintenance system. Reliability of technical systems – reliability of element until first failure. Empirical determination of element reliability and reliability of complex systems. Recovery process and strategies of replacements and reparations. Replacement models. Categorisation and planning of maintenance works. Standard malfunctions and methods for machine condition monitoring. Methodology for weak spots seeking. Maintenance costs. Spare parts. Inventory optimization. Inventory management – deterministic and stochastic models. Determination of indicators of maintenance system work. Queuing theory – finite source (calling population) systems.

practical teaching

Audit lessons (Maintenance position in company organisation structure. Reliability of element until first failure calculation. Reliability of complex systems – examples of serial, parallel, passive parallel, partially parallel relations between elements. Strategies and models of replacements – examples with and without discount factor (rate) and with compete and partial write-off. Repair (maintenance) complexity. Weak spots. Inventory management – deterministic and stochastic models. Queuing theory – finite source (calling population) systems – models with and without help between servicing channels.).
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

1. Bugaric, U.: Lecture handouts, Faculty of Mechanical engineering Belgrade, Belgrade, 2008-2011.
2. Bugaric, U., Petrovic, D.: Servicing system modelling, Faculty of Mechanical engineering Belgrade, Belgrade, 2011.
3. Bugaric, U.: Methodology for analysis of single position machines work, Foundation Andrejevic, Belgrade, 2003.
4. Bugaric, U., Petrovic, D.: Softvare for verification of sample belongings to theoretical distribution using chi-square test, Faculty of Mechanical engineering Belgrade, Belgrade, 1996-2010.
5. Klarin, M., Ivanovic, G., Stanojevic, P., Raicevic, P.: Principles of therotechnological actions, Faculty of Mechanical engineering Belgrade, Belgrade, 1994.
6. Software: QtsPlus 3.0 (Queuing theory software Plus).
7. Practical instruction in industrial environment (SKF, Siemens).
8. Mobile devices for measurement of temperature and vibrations.
9. Personal computers.

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

Baldin, A., Furlanetto, L., Roversi, A., Turco, F.: Handbook for maintenance of industrial plants, Održavanje Mašina i Opreme – OMO, Belgrade, 1979.
Ivkovic, S.: Failures of mining machine elements, Rudarsko-geološki fakultet Beograd, Belgrade, 1997.
Vukadinovic, S., Teodorovic, D.: Elements of reliability theory and recovery theory of technical systems (second edition), Privredni pregled, Belgrade, 1979.
Vujanovic, N.: Reliability theory of technical systems (second edition), Vojnoizdavački i novinski centar, Belgrade, 1990.
Hillier, F. S., Lieberman, G. J.: Introduction to operations research (seventh edition), McGraw-Hill, New York, 2000.

Management of Production Processess

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 the 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

Pratical 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

Basic concepts of production and operations management. Modern tendencies in the production and operations management. Lean Manufacturing. An example of Toyota production system. Principles of structuring of the production system. Contingency factors influence on design of the organization. Types of organizational structures. Products chart. Material Requirements Planning. Inventory management. The function of planning and analysis. Production cycle time. Production planning and scheduling. Techniques of network planning - CPM/PERT. The calculation of production capacity. Linear programming. Types of production. Technical and technological documentation. Time structure of the production cycle. Inventory control. Maintenance management. Quality management in manufacturing companies. Indicators of financial performance. Designing organizational structure.

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.(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)
Tersine J.R., Production/Operations Management: Concepts, Structure and Analysis, Appleton & Lange, New York, 2005.
Handout

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)
Tersine J.R., Production/Operations Management: Concepts, Structure and Analysis, Appleton & Lange, New York, 2005.
Stanford N., GUIDE TO ORGANISATION DESIGN - Creating high-performing and adaptable, Profile Books Ltd, London, 2007.

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

Č.Mitrović, S. Radojevic: Fundamentals of Web design, textbook: ISBN 978-86-7083-596-2, 164 pages., Full color, graphics, A4 format, published by Faculty of Mechanical Engineering, Belgrade 2007

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

Designing and managing the business of digital company/factory. Information and functional integration of the company. The integration of engineering, production and business activities and functions. Business performance of the integrated enterprise. Using commercial software. Application of new IC technologies. Further studies or employment.

learning outcomes

Understand the functioning of integrated company/factory. Apply new IC technologies. Criticize the production-business systems and processes. Design and modify processes and systems. Adopt the methods of management systems, processes and activities. Develop qualities of creative engineer. Working in the project team. Keep business conversations.

theoretical teaching

Model of information integration of the company. Model of functional integration of the company. Model CIMOS reference architecture. Definitions of business systems and business processes. Dynamics and complexity of business systems. Theory for the design of integrated digital enterprise. Functional entities and exchange of information. Enterprise activities, functional operations and business events. Supply chain management. Planning, (re)scheduling and execution of business operations. Information flow from operations of tools and materials. Optimum flow of jobs. Maintenance of the diagnosis. Reliability and tracking products through the life cycle. Integrated quality assurance system. The allocation of available resources. Multi-criterion decision-making. Integrated levels of management. Virtual Enterprise.

practical teaching

Functional analysis and synthesis of systems and processes. Integrated enterprise modeling and description of the business. Business-educational environment. Integrated database/knowledgebase and standard interfaces. Documentation and electronic exchange of information. IC infrastructure of companies. Development and life cycle of the business system. Engineering and reengineering of systems and business processes. Cost management. Business Performance of intelligent digital business enterprises. Business profile and marketing of companies/industries. Business plan and development of competitive enterprises. Software for management of integrated company.

prerequisite

Defined in the curriculum of study program/module.

learning resources

Spasić, Ž., Integrated system of quality of digital university, MF, 2007.
Spasić, Ž., Information integration of business functions, Textbook, MF, 2009.
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

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
Spasic, Ž., Integrated digital quality universities, Monograph, Faculty of Mechanical Engineering, Belgrade, 2007.
Spasic, Ž. Nedeljkovic, M., Bosnjak, S. Obradovic, A., University of Belgrade - Mission to the European integration process, Monograph, Faculty of Mechanical Engineering, Belgrade, 2003.
Faculty of Mechanical Engineering: Mechanical Engineering Alumni Fund - αMEβ, Editors Ž. Spasic and M. Nedeljkovic, B. Rosic, Č. Mitrovic, Releases Second Alumni Congress, Belgrade, 2007.

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 vallide 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 content. Comparing the quality of several available Web browser. Some limitations and advantages of Free Hosting. Analysis and resolution of simple communication problem. Responding to HTTP messages and warnings. Assessment for life cycle of WebSite and the strategy for maximum extension of the life cycle Web site. Understanding the tools to design and develop Web sites -applications with a short life expectancy. Assessment of cost efficient web site with a short life expectancy. Design, implementation and use of physical implementation of selected examples of Web sites.

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 instrumenataion
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

a) Auditoria exercises: 1. Engine piston mechanism and engine characteristic designs. Display of the characteristic designs of engine stationary and moving parts. Display of engine gas exchange systems characteristic designs. 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

1. M. Tomić, S. Petrović: Internal combustion engines, Faculty of Mechanical Engineering, Belgrade, 2008.
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 calculation of engine basic elements, Faculty of Mech. Eng., Belgrade, 1985.
Van Basshuysen, R., Schafer, F. (Editors): Internal Combustion Engine Handbook: Basics, Components, Systems, and Perspectives, SAE International, Warrendale, 2004. ISBN 978-0-7680-1139-5
A. Kolchin, V. Demidov: Design of automotive engines, English translation, Mir Publishers Moscow, 1984.
Challen, B., Baranescu, R. (Editors): Diesel Engine Reference Book - 2nd ed., Butterworth-Heinemann, Woburn, 1999. ISBN 0-7506-2176-1.

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

Practical application of statistical methods for analysis and predictions of engine failures. Expanding knowledge in the field of tribology through study of engine parts friction, wear and lubrication. Basics understanding of On-Board Diagnostic (OBD). Application of modern computer-based diagnostic methods. Gaining knowledge of engine repair processes, especially of major overhaul.

learning outcomes

Application of statistical methods for analysis of machine and devices failures. General structure and realization of machines and devices maintenance and overhaul processes. Ability to analyse and establish the cause of engine failure. Application of OBD procedures. Ability to organize and supervise engine maintenance and major overhaul processes.

theoretical teaching

Quality and durability of engines, operations quality and engine operational safety. Engine reliability and statistical methods of reliability analysis. Steady and unsteady engine operations. Fuel consumption. Engine parts and sub-assemblies wear characteristics. Engine technical diagnostic. On-Board diagnostic. Engine major overhaul, cost of overhaul. Influence of operational factors on engine reliability and wear. Operational characteristics, typical failures and maintenance processes of main engine parts, sub-assemblies and systems. Analysis of engine wear as a function of engine speed and load.

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

Greuter, E., Zima, S.: Motorschäden: Schäden an Verbrennungsmotoren und deren Ursachen, 2. Aufl., Vogel, Würzburg, 2000. ISBN 3-8023-1794-7. (in german)
Клюев, В. В. (ред.): Технические средства диагностирования, Машиностроение, Москва, 1989. ISBN 5-217-00637-4. (in russian)
Mollenhauer, K., Tschoeke, H. (ed.): Handbook of Diesel Engines. Springer-Verlag, Berlin, Heidelberg, 2010. ISBN 978-3-540-89082-9.
Challen, B., Baranescu, R. (ed.): Diesel Engine Reference Book, 2nd Ed., Butterworth-Heinemann, Woburn, 1999. ISBN 0 7506 2176 1.
Basshuysen, R. von, Schaefer, F.: Internal Combustion Engine Handbook, SAE, Warrendale, 2004. ISBN 0-7680-1139-6.

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
Jim Kring : LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition) , Prentice Hall, 2006, ISBN-13: 978-0131856721
Robert Bishop: LabVIEW 2009 Student Edition, Prentice Hall, 2010, ISBN13- 9780132141291
John Essick: Hands On Introduction to LabVIEW for Scientists and Engineers, Oxford University Press, USA, 2008, ISBN13- 9780195373950
Robert H. King:Introduction to Data Acquisition with LabVIEW,McGraw-Hill,2009,ISBN-13: 9780077299613

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

Application of engineer approach in analysis of machine and devices failures. General structure and realization of machines and devices maintenance and overhaul process. Ability to analyze and establish the cause of engine failure. Application of OBD procedures with modern vehicles. Ability to organize and supervise engine maintenance and major overhaul process.

theoretical teaching

1.Fundamentals of reliability of engines in exploitation, engine operations and operational quality and engine operational reliability. 2. Influence of engine operations on engine reliability and durability. 3. Typical failures of main engine parts and sub-assemblies. 4. Typical failures of engine systems. 5. Fundamentals of engine technical diagnostics. 6. Fundamentals of on- board engine diagnostics. 7. Fundamentals of engine disassembling , overhaul and assembling. 8. Control and testing of engine after assembling. 9. Influence of operational factors on reliability and wear of new and remounted engines. 11.Analysis of engine wear and fractures of basic engine parts

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

Greuter, E., Zima, S.: Motorschäden: Schäden an Verbrennungsmotoren und deren Ursachen, 2. Aufl., Vogel, Würzburg, 2000. ISBN 3-8023-1794-7. (на немачком)
Mollenhauer, K., Tschoeke, H. (ed.): Handbook of Diesel Engines. Springer-Verlag, Berlin, Heidelberg, 2010. ISBN 978-3-540-89082-9. (на енглеском)
Challen, B., Baranescu, R. (ed.): Diesel Engine Reference Book, 2nd Ed., Butterworth-Heinemann, Woburn, 1999. ISBN 0 7506 2176 1. (на енглеском)
Basshuysen, R. von, Schaefer, F.: Internal Combustion Engine Handbook, SAE, Warrendale, 2004. ISBN 0-7680-1139-6. (на енглеском)

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

1. Introduction; 2. Traction Power & Energy Consumption; 3.Operating principles and Performances of IC Engines; 4. Fuels, Renewable and Non-Renewable Energy Sources; Bio-Fuels and Hydrogen; 5. Electric Drives, Electric Hybrid Powertrain Systems (EHPS); 6. Regenerative Braking 7. Hydraulic Hybrid Powertrain Systems (HHPS); 8. Pneumatic Hybrid Powertrain Systems (PHPS), Energy Storage Systems: Types, Issues & Characteristics (Energy & Power Density), KERS; 9. Fuel Cells Fundamentals; 10. Trends in Powertrain Systems Development

practical teaching

1. Energy Storage Systems: Types, Issues & Characteristics (Energy & Power Density);
2. Power train System Losses, Rolling and Aerodynamic Resistance calculation (numerical examples); 3. IC Engines Performances calculation and Fuel Economy Analysis (numerical examples); 4. Fuels: toxic issues and CO2 emission comparative analysis; 5. Electric Drive & Hydraulic Machines Principles & Efficiency Maps; 6. KERS - Disposition and operation principle; 7. Hybrid Powertrain System Concept Analysis: Series/Parallel/Combined; 8. Developing simplified models of Powertrain System components in Matlab; 9. Simulation of Powertrain System behavior during standard driving cycles (EDC, NEDC, FTP75 etc.); Determination of Power System required Performance; Calculation of Fuel Economy Improvements by means of Regenerative Braking (Perfect and Real Recuperation, Start/Stop System). 10. Laboratory task: Hybrid Power train System demonstration

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

L. Guzzella, A. Sciarretta: Vehicle Propulsion Systems, Springer Verlag 2007., ISBN 978-3-540-74691-1
R. Hodkinson, J. Fenton: Lightweight Electric/Hybrid Vehicle Design, Butterworth-Heinemann, A division of Reed Educational and Professional Publishing Ltd, ISBN 0 7506 5092 3

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 auxulary 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)

- R. Jankov: Piston Compressors, Faculty of Mechanical Engineering, Belgrade, 5th edition, 1990 (in serbian)
- 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

Bloch, H. P, Hoefner, J. J.: Reciprocating compressors: operation and maintenance, Butterworth-Heinemann, Woburn, 1996. ISBN 0-88415-525-0.
Brown, R. N.: Compressors: selection & sizing – 2nd ed., Butterworth-Heinemann, Woburn, 1997. ISBN 0-88415-164-6.
Bendler, H., Spengler, H. (ed.): Technisches Handbuch Verdichter, Veb Verlag Technik, Berlin,1986.
Frenkel, M., I.: Kolbenverdichter, Veb Verlag Technik, Berlin,1969.

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
- R. Jankov: Piston Compressors, Faculty of Mechanical Engineering, Belgrade, 5th edition, 1990

- 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

Bloch, H. P, Hoefner, J. J.: Reciprocating compressors: operation and maintenance, Butterworth-Heinemann, Woburn, 1996. ISBN 0-88415-525-0.
Brown, R. N.: Compressors: selection & sizing – 2nd ed., Butterworth-Heinemann, Woburn, 1997. ISBN 0-88415-164-6.
Bendler, H., Spengler, H. (ed.): Technisches Handbuch Verdichter, Veb Verlag Technik, Berlin,1986.
Frenkel, M., I.: Kolbenverdichter, Veb Verlag Technik, Berlin,1969.

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

Introductory considerations. Analysis of engine ideal thermodynamic cycles. Engine real operating cycle: gas exchange process, combustion process in Otto and Diesel engines. Engine working parameters: indicated parameters, mechanical losses, effective parameters. Engine supercharging: role, types and characteristics of supercharging systems. Engine dynamic problems: gas and inertia forces, force transfer through engine mechanism, non-uniformity of angular velocity, balancing of inertia forces and their moments. Engine operating characteristics: with respect to engine speed and load, propeller type characteristics, universal characteristics. Engine ecological problems: toxic components of exhausts in Otto and Diesel engines, and the ways to reduce them.

practical teaching

Auditory exercises: Analysis of different type engine design characteristic. Engine working substances: types of fuels and their properties. Numerical examples in engine thermodynamic cycles. Fuel supply systems for Otto and Diesel engines. Numerical examples of engine working parameters, engine charging and supercharging and heat balance. Numerical examples of engine mechanism kinematics and dynamics. Engine systems and devices: ignition system, starting system, cooling system – air-cooled and liquid-cooled engines, lubricating system. Fundamentals of engine testing and preparation of laboratory exercises for engine testing.

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

1. M. Tomić, S. Petrović: Internal Combustion Engines, FME, Belgrade, 2004, /In Serbian/ available at the FME Library
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)
4. Measuring-acquisition system: National Instruments PXI-1042-RT8186/5401/6123/6229/4070 /6602/8461
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

Miroljub Tomić, Stojan Petrović: Motori sa unutrašnjim sagorevanjem, Fac. of Mech. Engineering, Belgrade,ISBN 978-86-7083-646-4
Richard Stone: Introduction to IC Engines, SAE International, ISBN-13: 978-0768004953
John Heywood: Internal Combustion Engine Fundamentals, ISBN-13: 978-0070286375
C. R. Ferguson: Internal Combustion Engines, J.Wiley & Sons 1986, ISBN 0-471-88129-5

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

General specifications: Application of engineer approach in analysis of machine and devices failures. General structure and realization of maintenance of machines and devices and their overhaul. Ability to analyze and establish the cause of engine failure. Application of OBD ("on-board") procedures with modern vehicles. Ability to organize and supervise engine maintenance and major overhaul process.

theoretical teaching

1. Fundamentals of reliability of engines in exploitation, engine operations and operational quality and engine operational reliability 2. Influence of engine operations on engine reliability and durability. 3. Typical failures of main engine parts and sub-assemblies. 4. Typical failures of engine systems. 5. Fundamentals of engine technical diagnostics. 6. Fundamentals of "On-Board" engine diagnostics. 7. Fundamentals of engine disassembling , overhaul and assembling. 8. Control and testing of engine after assembling. 9. Influence of operational factors on reliability and wear of new and remounted engines. 10.Typical operations of engine maintenance during exploitation. 11.Analysis of engine wear and fractures of basic engine parts.

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

Клюев, В. В. (ред.): Технические средства диагностирования, Машиностроение, Москва, 1989. ISBN 5-217-00637-4. (in russian)
Mollenhauer, K., Tschoeke, H. (ed.): Handbook of Diesel Engines. Springer-Verlag, Berlin, Heidelberg, 2010. ISBN 978-3-540-89082-9.

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 auxulary 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)
- R. Jankov: Piston Compressors, Faculty of Mechanical Engineering, Belgrade, 5th edition, 1990

(in serbian)
- 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

Bloch, H. P, Hoefner, J. J.: Reciprocating compressors: operation and maintenance, Butterworth-Heinemann, Woburn, 1996. ISBN 0-88415-525-0.
Brown, R. N.: Compressors: selection & sizing – 2nd ed., Butterworth-Heinemann, Woburn, 1997. ISBN 0-88415-164-6.
Bendler, H., Spengler, H. (ed.): Technisches Handbuch Verdichter, Veb Verlag Technik, Berlin,1986.
Frenkel, M., I.: Kolbenverdichter, Veb Verlag Technik, Berlin,1969.

material handling, constructios and logistics

Elements of Construction and Mining Machines
Fundamentals of steel structures
Material Handlig 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

Short survey on the development of construction and mining machines. Technology of earthmoving work in construction industry and mining. Basic structural scheme of construction and mining machines. Types of working devices and equipment. Drive and transmission systems. Main design parameters. Interaction between cutting elements and soil. Excavators and loaders. Equipment for preparation, excavation transport and planning. Machines for soil stabilization. Machines and plants for aggregate production, production and installation of concrete and asphalt concrete.

practical teaching

Calculation of backhoe excavators, power shovels (front shovels), dragline excavators and loaders. Calculation of basic geometrical parameters of bucket (width, height, length) of known volume. Adoption and calculation of basic geometrical parameters of teeth (width, length, cutting angle, geometry of the cutting wedge, rear angle). Calculation of working loads caused by soil excavation. Load analysis of excavating device. Static stability. Calculation of loader. Conceptual design of mini excavator. Consultations.

prerequisite

Required previously passed courses: Engineering Graphics, Strength of Materials, Material Science, Machine Elements 1.

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. Srđan 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

Momir M. Plavšić, Construction Machines, Scientific Book, Belgrade, 1990.

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

Properties of structural steel and effects of steelmaking and fabrication. Mechanical properties. Types of loads. Design criteria for: stresses, deflections, structural stability, connections (bolting and welding), fatigue, basics of structural vibrations, geometric stability and buckling. Basic behaviour of structural components. Design methods. Axial loaded members (tension and compression). Rolled section beams (bending). Trusses (statically determinate).

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.
Advisible 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 Handlig 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, constructios 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

Required: Engineering graphics, Materials strength, Materials scinece, Machine elements 1.
Desirable: Machine elements 2.

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 mechines 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

Internal documentation of the company.Tosic, S.: Transport equipment - Machinery Transport, Belgrade, 1999., Ostric, D., Tosic, S.: Cranes, Belgrade, 2005, Petkovic, Z.: Metal Structures in Mechanical engineering, Belgrade, 1996., Bosnjak S .: Bucket wheel excavators, Belgrade, 2001., Zrnic, Đ., Prokic, M., Milovic, P.: design foundry, Belgrade.

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

S. Tosic, Transport equipment - Machinery Transport, Belgrade, 1999.
Ostric D., S. Tosic, Cranes, Belgrade, 2005.
Z. Petkovic, Metal construction in Mechanical engineering, Belgrade, 1996.
Bosnjak S., Bucket wheel excavators, Belgrade, 2001.
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

Introduction to computer modeling. The differences of visually oriented software package (3D StudioMAX, Maya) in relation to technically oriented (AutoCAD, SolidWorks). Problems in the use of models from AutoCAD to 3D StudioMAX-in. Introduction to StudioMAX 3D interface. Viewport. Working with Objects. Subobjects. Modeling. Modifiers, modifiers stack. Spline, patch and poly modeling. Materials. Material mappings. Textures. Cameras. Lights and basic lightning techniques. Introduction to animation. Motion panel. Keyframes. Animate objects. Controllers & constraints. Motion mixer. Rendering. Rendering pipeline. Rendering a scene. Shaders. Rigging. Bones construction and usage.

practical teaching

Setting the render parameters. Using the render window. Elements of menus, toolbars and default settings. Introducing a viewport. The methods of navigation. Setting the viewport and display modes. Using background images and animations. Working with shortcuts. Important existing shortcuts and creating new ones. Creation and selection of primitive objects. Setting the parameter objects. Basic objects and transforming work of the shaft. Cloning, sequences, layer, linking and grouping objects. Use modifier. Working with subobjects. Quad structure and subdivision. Box modeling through practical examples and tutorials. Working with the parameters of standard materials. The use of textures and maps. UVW Mapping. Unwrap UVW. Using a skin modifier. Exercise of modeling, texturing and rendering on practical examples.

prerequisite

Advanced computer skills.

learning resources

References: Kelly L. Murdock, 3ds Max Bible, Wiley Publishing, 2011.
Barry G. Blundell: An Introduction to Computer Graphics and 3D Creative Enviroment,

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.
Barry G. Blundell: An Introduction to Computer Graphics and 3D Creative Enviroment, Springer - Verlag, 2008

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

Limitations of computational technique and error management in numerical procedures. Introduction to MATLAB. Types of data. Solving non-linear equations. Solving the system of non-linear equations. Differentiation. Integration. Solving differential equations. Series. Matrices. Procedures of linear algebra. 2D graphics in MATLAB. 3D graphics in MATLAB. Programming in MATLAB – scripts. Programming in MATLAB – functions. Solving the system of differential equations. Examples of MATLAB engineering application.

practical teaching

Limitations of computational technique and error management in numerical procedures. Introduction to MATLAB. Types of data. Solving non-linear equations. Solving the system of non-linear equations. Differentiation. Integration. Solving differential equations. Series. Matrices. Procedures of linear algebra. 2D graphics in MATLAB. 3D graphics in MATLAB. Programming in MATLAB – scripts. Programming in MATLAB – functions. Solving the system of differential equations. Examples of MATLAB engineering application.

prerequisite

No prerequisites.

learning resources

S. Radojević, A. Cvetković, I. Aranđelović, G. Lazović, A. Jandrlić, D. Jandrlić,
MATLAB - sloved examples - electronic edition

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

V. Simonović, Numerical methods, Belgrade 2008.
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

The C programming Language, Dennis M. Ritchie, Brian W.Kernighan, ISBN 0-13-110362-8

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

Basic concepts of probability theory. Random events. Conditional probability of an event. Total probability formula. Bayes formula. Bernoulli's Formula and its approximations. Random variables. Central limit theorem. Regression. Mathematical statistics mission. Generally about estimation of distribution parameters. Estimating expected value and variance of a random variable. Methods for estimating distribution parameters. Confidence intervals. Statistical hypothesis testing. Least squares method. Reliability of technical systems. Nonparametric hypothesis testing.

practical teaching

Basic concepts of probability theory. Random events. Conditional probability of an event. Total probability formula. Bayes formula. Bernoulli's Formula and its approximations. Random variables. Central limit theorem. Regression. Mathematical statistics mission. Generally about estimation of distribution parameters. Estimating expected value and variance of a random variable. Methods for estimating distribution parameters. Confidence intervals. Statistical hypothesis testing. Least squares method. Reliability of technical systems. Nonparametric hypothesis testing.

prerequisite

No prerequisites.

learning resources

I. Aranđelović, Z. Mitović, V. Stojanović, Probability and Statistics, Zavod za udžbenike i nastavna sredstva, Beograd 2011.

I. Aranđelović, Theory of random events, Vedes, Beograd 2005.

S. Radojević, Z. Veljković, Statistical methods, electronic edition, Beograd 2003.

number of hours

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

V. Simonović: Introduction to theory of probability and mathematical statistics, Naučna knjiga, Beograd, 1995.
Z. A. Ivković: Theory of probability and mathematical statistics, Građevinska knjiga, Beograd, 1980.
S. Vukadinović: Elements of theory of probability and statistics, Beograd 1986.
B. Vidaković, D. Banjević, Probability and statistics, exercises , Beograd 1989.
M. Nenadović, Mathematical analysis of measurment dates, Beograd 1988.

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 differential 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

M.Krasnov, A. Kiselev, G.Makarenko, E. Shikin: Mathematical Analysis for Engineers, Volume I, II, Mir Publishers, Moscow, 1990.
Larson, Hostetler, Edwards CALCULUS, Lexington, Massachusetts, Toronto, 1990.

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 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 differential 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: 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

M.Krasnov, A. Kiselev, G.Makarenko, E. Shikin: Mathematical Analysis for Engineers, Volume I, II, Mir Publishers, Moscow, 1990.
Larson, Hostetler, Edwards CALCULUS, Lexington, Massachusetts, Toronto, 1990.

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 (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: 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
S. Nešić: Mathematics 1, exercises , Mašinski fakultet, Beograd, 1995.
Z. Mamuzić, B. Đerasimović, V. Simonović: Mathematical analysis, Naučna knjiga, Beograd, 1991.
S. Nešić, R. Radovanović: Mathematcs 2, exercises , Mašinski fakultet, Beograd, 1990.

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

M.Krasnov, A. Kiselev, G.Makarenko, E. Shikin: Mathematical Analysis for Engineers, Volume I, II, Mir Publishers, Moscow, 1990.
Larson, Hostetler, Edwards CALCULUS, Lexington, Massachusetts, Toronto, 1990.

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:

http://mat.mas.bg.ac.rs

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

M.Krasnov, A. Kiselev, G.Makarenko, E. Shikin: Mathematical Analysis for Engineers, Volume I, II, Mir Publishers, Moscow, 1990.
Larson, Hostetler, Edwards CALCULUS, Lexington, Massachusetts, Toronto, 1990.

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:

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

M.Krasnov, A. Kiselev, G.Makarenko, E. Shikin: Mathematical Analysis for Engineers, Volume I, II, Mir Publishers, Moscow, 1990.
Larson, Hostetler, Edwards CALCULUS, Lexington, Massachusetts, Toronto, 1990.

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

Numerical series. Convergence, divergence. Harmonical series. Series with positive elements. Dalambert and Cauchy convergence criterion. Alternative series. Liebnitz convergence criterion. Absolutely and semiconvergent series. Functional series. Uniform convergence. Weierstreiss theorem. Properties of uniformly convergent series. Potential series. Taylor and Maclaurin series. Trigonometrical series.
Absolut and relative error. Number representation. Floating point representation. Significant and stable digits. IEEE-754-2008. Classes single and double in Matlab. MAchine precision. Arithmetic operations with rounded numbers and error propagation. General function computation with approximate arguments. Computation stability. Ill conditioning. Linear systems. Gauss method. LU decomposition. Solving linear systems in Matlab. Iterative methods for linear systems. Gauss-Seidel method. Interpolation. Lagrange and Newton interpolation polynomial. Numerical differentiation. Interpolation and differentiation in Matlab. Nonlinear equations and systems. Newton method. Newton's method. Solution of nonlinear equations in Matlab. Numerical integration. Newton-Cotes quadrature rules. Numerical integration in Matlab. Ordinary differential equations. Cauchy problem. Euler's method. Explicit and implicit methods (Adams-Bashforth, Adams-Moulton). Runge-Kutta methods. Solving ODE in Matlab.

practical teaching

Series. Comparasion convergence criterion. Dalambert and Cauchy convergence criterion. Alternative series. Liebnitz convergence criterion. Absolutely and semiconvergent series. Functional series. Uniform convergence. Weierstreiss theorem. Properties of uniformly convergent series. Potential series. Expansion in potential series. Trigonometrical series. Apsolut and relative error. Number representation. Floating point representation. Significant and stable digits. IEEE-754-2008 and function num2hex. Classes single and double in Matlab. Machine precison and function eps. Cancelation of significant digits during computation. Function computation with approximate argument values. Computation stability. Ill conditioning. Linear systems. Gauss method and LU decomposition implementation. Function linsolve. Matrix inversion and operators \ and /. Pivoting. Iterative methods for linear systems.

Gauss-Seidel method implementation. Interpolation. Implementation of different methods of interpolation and function interpol1 in Matlab. Numerical differentiation. Implementation of numerical differentiation and function diff. Nonlinear equations and systems of equations. Newton's method. Implementation of Newton's method. Numerical integration and function integral. Trapezoidal rule and function trapz. Solution to ODE. Implementation to Euler's method. Runge-Kutta methods and function ode45.

prerequisite

No prerequisites.

learning resources

Literature: M. Spalevic, M.S. Pranic, Numerical Methods, Skver, Kragujevac, 2007.
G.V. Milovanovic, M. Kovacevic, M. Spalevic, Numerical Analysis - Collection of solved problems, University of Nis, 2003.
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

М. Спалевић. М.С. Пранић, Нумеричке Методе, Сквер, Крагујевац, 2007.
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

Series. Convergence criteria. Series summing. A series of functions. Uniform convergence. Functional series. Uniform convergence. Continuity of a sum, differentiation and integration. Power series. Cauchy-Hadamard theorem. Taylor’s and Maclauren’s series. Leibnitz criterion and error estimation. Calculation errors and avoiding them. Limitations of computational techniques. Error management in numerical procedures. Interpolation polynomials. Extrapolation. Numerical differentiation. Numerical integration. Newton - Cotes formulas. Numerical procedures in linear algebra. Reduction of numerical error in Gauss procedure. Iterative procedures (Jacobi and Gauss-Saidel). Numerical solving of differential equations. Runge-Kutta method. Least squares method. Linear, polynomial, non-linear and multiple linear regression. MATLAB applications. A more complex procedures in MATLAB. Use of scripts and functions. Regression analysis in MATLAB with graphic representations.

practical teaching

Series. Convergence criteria. Series summing. A series if functions. Uniform convergence. Functional series. Uniform convergence. Continuity of a sum, differentiation and integration. Power series. Cauchy-Hadamard theorem. Taylor’s and Maclauren’s series. Leibnitz criterion and error estimation. Calculation errors and avoiding them. Limitations of computer techniques. Error management in numerical procedures. Interpolation polynomials. Extrapolation. Numerical differentiation. Numerical integration. Newton-Cotes formulas. Numerical procedures in linear algebra. Reduction of numerical error in Gauss procedure. Iterative procedures (Jacobi and Gauss-Saidel). Numerical solving of differential equations. Runge-Kutta method. Least squares method. Linear, polynomial, non-linear and multiple linear regression. MATLAB applications. A more complex procedures in MATHLAB. Use of scripts and functions. Regression analysis in MATLAB with graphic representations.

prerequisite

No prerequisites.

learning resources

1. M. Spalević, M. Pranić, Numerical methods,
University of Kragujevc, Faculty of sciences and mathematics, Kragujevac,
2007.

2. G. V. Milovanović, M. A. Kovačević, M. M. Spalević, Numercal mathematics, selected problems, University of Nis, Faculty of electronics, Niš, 2003.

3. V.Simonović, Numerical methods, Faculty of Mechanical Engineering, Beograd 2008.

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

G. V. Milovanović, Numerical analysis, I part, Naučna knjiga, Beograd, 1991.
G. V. Milovanović, Numerical analysis, II part, Naučna knjiga, Beograd, 1991.
G. V. Milovanović, Numerical analysis, III part, Naučna knjiga, Beograd, 1991.
Walter Gautschi, Numerical analysis: an introduction, Birkhäuser, Boston, 1997.

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

Object Oriented Programming vs Structural and procedural programming. Objects and Classes. Properties and Methods. Client and Server model.Creating objects. Accessing objects and Message Passing. Java fundamentals. Expressions, Statements, and Control-flow Mechanisms. Blocks - Local Declarations. Arrays. Implementation. Classification. Hierarchical Relationship of Classes. Specialization and Generalization. Superclass and Subclass. A Class Hierarchy Diagram. UML. Organization of Class Hierarchy. Code Reuse. Making Changes in Class Hierarchy. Inheritance of properties. Multiple Inheritance. Interface. Polymorphism. Static properties and methods. Using Exceptions. Exception Terminology. Input and Output Operations. An Introduction to the Java API. Reading the Java API Documentation. Basic Input and Output. Java Generics. Generic Class. Generic Method. Swing fundamentals. Networking in Java.

practical teaching

Classification, generalization and specialization. Introduction to UML. UML and class hierarchy. Examples of class diagrams. Introduction to NetBeans. Implementation of class diagrams in Java. Compilation and execution. Debugging. Packages java.io, java.math and java.util. Event driven programming. Package javax.swing. Sockets in Java.

prerequisite

Advanced computer skills and knowledge of at least one programming language.

learning resources

References: Danny Poo, Derek Kiong, Swarnalatha Ashok, Object-Oriented Programming and Java, Second edition, Springer-Verlag London Limited 2008.
K. Barclay, J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.

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

Danny Poo, Derek Kiong, Swarnalatha Ashok, Object-Oriented Programming and Java, Second edition, Springer-Verlag London Limited 2008
K. Barclay, J. Savage, Object Oriented Design with UML and Java, Elsevier, 2004.

PROGRAMMING

ID: BSc-0014
teaching professor: Аранђеловић Д. Иван
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 4
final exam: written+oral
parent department: mathematics

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

Computers – Hardware (organization, ROM and RAM, CPU, I/O units). Basic operations of mathematical logic. Mathematical models. Algorithms. Software. (System and application software, operating systems, programming languages). The FORTRAN programming language. Language lexical and syntactic structure. Types of data and variables. Input and output statements. Arithmetic and logic statements. Program flow control statements. Loop statements. Sequences and matrices. Structured data types. Subroutines. Formatted input and output. Libraries. Programming techniques (lists, stacks, recursions, sorting and browsing). Numerical procedures – interpolation and approximation. Algorithms for approximate equations solving. Examples of programming application in mechanical engineering.

practical teaching

Computers – Hardware (organization, ROM and RAM, CPU, I/O units). Basic operations of mathematical logic. Mathematical models. Algorithms. Software. (System and application software, operating systems, programming languages). The FORTRAN programming language. Language lexical and syntactic structure. Types of data and variables. Input and output statements. Arithmetic and logic statements. Program flow control statements. Loop statements. Sequences and matrices. Structured data types. Subroutines. Formatted input and output. Libraries. Programming techniques (lists, stacks, recursions, sorting and browsing). Numerical procedures – interpolation and approximation. Algorithms for approximate equations solving. Examples of programming application in mechanical engineering.

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

I. Aranđelović, G. Lazović, V. Šešum, A. Jandrlić, D. Golubović, Introduction to FORTRAN, VEDES, Beograd 2006.
M. Milačić, R. Radovanović,... Programming - FORTRAN 77, Mašinski fakultet, Beograd 1996.
N. Parezanović, D. Kolar, FORTRAN 77, Naučna knjiga, Beograd 1992.
N. Parezanović, FORTRAN 90, Nauka, Beograd 1993.

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

The basic concepts of anthropometry and elements of functional anatomy, biomechanics of human limbs and other functional parts of the human body. Biomechanical properties of bones, muscles, joints, tendons and ligaments. Biomechanics of the shoulder, elbow, hand, spine, hip, foot:rheological models. Statics of musculoskeletal system of humans. The concept of locomotion, types of locomotions.Kinematics of the human locomotor system (HLS) and motor tasks. The task of direct and inverse dynamics of HLS. Motion,the energy aspects of: work, energy, power. Biomechanics of internal organs and organ systems.Basic concepts of tissue biomechanics. Fundamentals of kinematic mechanisms. Model mechanism of HLS in the form of kinematic chains with branching-differential equations of motion (DIFE)-example of the upper body;example of closed kinematic chain: bipedal locomotion. Biomechanics of walking/bipedal locomotion. Orthopaedic biomechanics.

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 techniquesin 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

[1]Y.Fung,Biomechanics:Mechanical Properties of Living Tissues,Springer,2000.(KSJ)
[2]Winter,D.A.Biomechanics of Human Movement,John Wiley&Sons,1990.(KSJ)
[3]Nordin M,Frankel V,Basic biomechanics of the musculoskeletal system,Lea &Febiger,London,1980.(KSJ)
[4]Tozeren A.Human Body Dynamics-Classical Mechanics and Human Movement, Springer Verlag,2000.(KSJ)
[5]Lazarević, M. Basics Biomechanics, (script in preparation),2011.
[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

Duane Knudson,Fundamentals of Biomechanics,Springer Science+Business Media, LLC,2007.
D. Schneck, J. Bronzino,Biomechanics : principles and applications, CRC PressLLC,2003.
Y. Hong and R. Bartlett,Routledge Handbook of Biomechanics and Human Movement Science,Routledge,2008.
C. Oomens, M. Brekelmans, F. Baaijens,Biomechanics: Concepts and Computation,Cambridge University Press,,2009
S. Cowin, S. B.Doty,Tissue Mechanics, Springer Science+Business Media, LLC,2007

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

Statics in Engineering. Basic Concepts. Axioms of Statics. Constrained Body. Constraints and Reactions of Constraints. Constraint Removal Principle. Conditions of Equilibrium of Concurrent Force System. Equilibrium of Three-force System. Moment of a Force about a Point and Axis. Couple. Moment of a Couple. Equivalence of Couples. Equilibrium of Couple Systems. Fundamental Theorems of Statics. Reduction of Force Systems. Condition of Equilibrium of Force Systems. Center of Parallel Force System. Center of Gravity of a Body. Center of Gravity Determination. Guldin's Theorems. Types of Loads. forces and Moments in Cross-section of Structures. Plane Structres. Free Body Diagrams. Plane Trusses. Friction. Real Constraints. Rolling resistance.

practical teaching

Conditions of equilibrium of concurrent force system. Equilibrium of Three-force system, Conditions of Equilibrium of Force Systems. Center of Gravity of a Body. Center of Gravity Determination. Guldin's Theorems. Forces and Moments in Cross-section of Structures. Plane Structures. Free Body Diagrams, Plane Trusses. Friction. Real Constraints. Rolling resistance.

prerequisite

no

learning resources

[1] Golubović, Z., Simonović, M., Mitrović, Z., Mechanics - Statics, Faculty of Mechanical Engineering, Belgrade, 2007.
[2] Glišić, M., Trišović, N., Jeremić, O., Milićev, S., Zeković, D., Collection of examples from Statics with appendix in theory, Faculty of Mechanical Engineering, Belgrade, 2007.
[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

Lukačević, M., Čović, V., Statics, Gradjevinska knjiga, 1996.

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

Basic Concepts of Kinematics. Determination of Motion of a Particle – Vector and Natural. Particle Velocity. Determination of Particle Velocity in Various Types of Coordinate Systems. Particle Acceleration. Determination of Particle Acceleration. Basic Terms of Kinematics of a Rigid Body. Translation. Rotation of a Rigid Body about a Fixed Axis. Angular Velocity and Angular Acceleration of a Rigid Body. Planar Kinematics of a Rigid Body. Spherical Kinematics of a Rigid Body. Relative Motion of a Particle. Velocity and Acceleration of a particle in Relative Motion. Free Particle Dynamics. Direct and Inverse Tasks of Dynamics. System of Particles. Constraints. Euler’s and Lagrange’s equations of Motion of a Particle. Center of Inertia. Moments of Inertia.

practical teaching

Determination of Motion of Particle – Vector and Natural. Determination of Particle Velocity in Various Types of Coordinate Systems. Determination of Particle Acceleration. Translation. Rotation of a Rigid Body about a Fixed Axis. Angular Velocity and Angular Acceleration of a Rigid Body. Planar Kinematics of a Rigid Body. Spherical Kinematics of a Rigid Body. Velocity and Acceleration of a Particle in Relative Motion. Free Particle Dynamics. System of Particles. Constraints. Euler’s and Lagrange’s equations of Motion of a Particle. Center of Inertia. Moments of Inertia.

prerequisite

Defined by curriculum.

learning resources

[1] Mladenović, N., Mechanics 2, Kinematics, Faculty of Mechanical Engineering, Belgrade, 1996.
[2] Simonović, M., Mitrović, Z., Golubović, Z., Mechanics - Kinematics, Faculty of Mechanical Engineering, Belgrade, 2011.

[3] Mladenović, N., Mitrović, Z., Stokić, Z., Collections of examples for Kinematics, Faculty of Mechanical Engineering, Belgrade, 2007.
[4] Mitrović, Z., Simonović, M., Golubović, Z., Mechanics - Dynamics of particle, Faculty of Mechanical Engineering, Belgrade, 2011.
[5] Trišović, N., Lazarević, M., Practicum for Mechanics, Statics and Kinematics, Faculty of Mechanical Engineering, Belgrade, 1999.
[6] 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

Rusov, L., Kinematics, Naučna knjiga, 1983.
Đurić, S., Kinematics, Faculty of Mechanical Engineering, Belgrade, 1990.
Pavišić, M., Stokić, Z., Trišović, N., Practicum for Mechanics, Particle Dynamics. Mechanical System Dynamics, Faculty of Mechanical Engineering, Belgrade,1998.

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

Linear Momentum of a Particle and a Mechanical System. Impulse. Impulse-Linear Momentum Theorem and Law of Conservation of Linear Momentum. Angular Momentum of a Particle and a Mechanical System. Angular Impulse-Angular Momentum Theorem and Law of Conservation of Angular Momentum. Differential and Total Work of a Force. Force Field. Force Function. Conservative Force. Kinetic Energy of a Particle and a Mechanical System. Work-Kinetic Energy Theorem and Law of Conservation of Kinetic Energy of a Particle and a Mechanical System. Central Force. Conservation of the Areal Velocity. Differential Equations of Motions for a Particle subjected to Central Force. Binet Equation. Motion of a Particle subjected to Newtonian Gravity. Kepler's Laws. Dynamics of Relative Motion of a Particle. Linear Vibration of a Particle. Free and Forced. Damped and Undamped Vibration of a Particle. D'Alamber Principle. Differential Equation of Motions of a Rigid Body (Translation, Rotation about a Fixed Axis, Planar and Spherical Motion of a Rigid Body). Basics of Analytical Mechanics.

practical teaching

Impulse-Linear Momentum Theorem and Law of Conservation of Linear Momentum. Angular Impulse-Angular Momentum Theorem and Law of Conservation of Angular Momentum. Differential and Total Work of a Force. Force Field. Kinetic Energy of a Particle and a Mechanical System .Work-Kinetic Energy Theorem and Law of Conservation of Kinetic Energy of a Particle and a Mechanical System. Central Force. Conservation of the Areal Velocity. Differential Equations of Motions for a Particle subjected to Central Force. Binet Equation. Motion of a Particle subjected to Newtonian Gravity. Kepler's Laws. Dynamics of Relative Motion of a Particle. Linear Vibration of a Particle. Free and Forced, Damped and Undamped Vibration of a Particle. D'Alamber Principle. Differential Equation of Motions of a Rigid Body (Translation, Rotation about a Fixed Axis, Planar and Spherical Motion of a Rigid Body). Basic of Analytical Mechanics.

prerequisite

Defined by the curriculum study program

learning resources

[1] Mitrović, Z., Simonović, M., Golubović, Z., Mechanics - Dynamics of particle, Faculty of Mechanical Engineering, Belgrade, 2011.
[2] Pavišić, M., Golubović, Z., Mitrović, Z. Mechanics - Dynamics of mecnanical systems, Faculty of Mechanical Engineering, Belgrade, 2011.
[3] Vuković, J., Simonović, M., Obradović, A., Marković, S., Collections of examples for Dynamics, Faculty of Mechanical Engineering, Belgrade, 2007.
[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.
Rusov, L., Dynamics, Naučna knjiga, 1988.

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

Stability of equilibrium of the conservative system. Silvester's criteria. Linearization of the differential equations of motion. Vibration of the conservative system. Frequencies. The main mode shapes of vibration. Modal matrix. Conservative systems with special values of natural frequencies (eigenvalues). Vibration of the body on the beam supports. Damped vibration. Forced undamped vibration. Forced vibration. Resonance. Beating. Dynamic amplification factor. The dynamic absorber without damping. Linear oscillations of non-stationary system. Forced damped vibration of the system. Lateral vibration of string. Longitudinal vibration of prismatic bodies. Torsional vibration of the shaft with circular cross section. Lateral vibration of prismatic bodies.

practical teaching

Stability of equilibrium of the conservative system. Silvester's criteria. Linearization of the differential equations of motion. Vibration of the conservative system. Frequencies. The main mode shapes of vibration. Modal matrix. Conservative systems with special values of natural frequencies (eigenvalues). Vibration of the body on the beam supports. Damped vibration. Forced undamped vibration. Forced vibration. Resonance. Beating. Dynamic amplification factor. The dynamic absorber without damping. Linear oscillations of non-stationary system. Forced damped vibration of the system. Lateral vibration of string. Longitudinal vibration of prismatic bodies. Torsional vibration of the shaft with circular cross section. Lateral vibration of prismatic bodies.

prerequisite

The subject can take students who have made a condition for entry into the third year of study.

learning resources

Vuković, J., Obradović,A., Linear vibrations theory of mechanical systems, Mašinski fakultet, Beograd, 2007.,

handouts

Ružić D., Čukić R., Dunjić M., Milovančević M., Anđelić N., Milošević-Mitić V.: Strength of Materials,Book 5, Tables, Mašinski Fakultet, Beograd 2007.

Lazić D., Ristanović M.: Introduction to MATLAB , Mašinski fakultet, Beograd 2005.

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

Vuković, J., Obradović,A., Linear vibrations theory of mechanical systems, Mašinski fakultet, Beograd, 2007.,
Vujanović B.: Theory of vibrations, Fakultet tehničkih nauka, Novi Sad 1995.
Kojić M., Mićunović M.: Theory of vibrations, Naučna knjiga, Beograd 1991.
Vujičić V.: Theory of vibrations, Naučna knjiga, Beograd 1977.
Rao S.S.: Mechanical vibrations, Addison-Wesley Publishing Company Inc., 1995.

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, exploatation, maintenance, revitalization, etc.

learning outcomes

With this practice, students in particular conditions (vehicle and other systems production, maintenance, testing and exploatation), acieve practical view in production segments of elements, components and Vehicle systems, as well as problems of vehicle/systems mounting as a final product, their exploatation, 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 especialy 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, whic 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 proopulsion: 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 characterisctics, 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 calssification 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 systes – 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.
D. Jankovic, J. Todorovic, G. Ivanovic, B. Rakicevic: Theory of Vehicle Motion, Faculty of Mechanical Engineering, Belgrade, 2000.
N. Janicijevic, D. Jankovic, J. Todorovic: Construction of Motor Vehicles, Faculty of Mechanical Engineering, Belgrade, 2000.
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

J. H. Smith, An Introduction to Modern Vehicle Design, Butterworth – Heinemann, 2001

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

3. D. Jankovic: Instructions for Dynamic Calculation of Motor Vehicles, Faculty of Mechanical Engineering, Belgrade, 1992, 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
Reza N. Jazar: Vehicle Dynamics: Thaory and Applications, Springer, 2008
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. Acquirement 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

Practical course contains three cycles of exercises: Cycle 1: Determination of vehicle dimensions, frontal area, gravity center and moments of inertia of vehicle elements and assemblies. Cycle 2: Testing od braking characteristics and noise. Cycle 3: Testing of vehicle elements, components and assemblies characteristics.

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

(1) Introduction (terms and definitions). System driver – vehicle – environment (road). Intelligent traffic solutions. (2) Vehicle safety as a part of traffic safety. (3) Requirements imposed to motor vehicles from the driver and environment point of view. (4) Influencing parameters on motor vehicles safety. (5) Concept, mission, tasks, operation, and performance of safety related vehicle systems. (6) Vehicle stability versus an interaction and load distribution between wheels and road surfaces during braking, driving, and steering in different driving situations. (7) Ecological aspects of vehicle safety. (8) Advanced driver assistance systems and motor vehicle safety. (9) Mechatronic solutions of safety - related motor vehicle systems. (10) Regulations and Directives in motor vehicles safety.

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) Guidlines 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

1, D. Jankovic., J. Todorovic, G.Ivanovic, B. Rakicevic: Theory of Vehicle Motion, Faculty of Mechanical Engineering, Belgrade, 2001
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

G. Peters, B. Peters, Automotive Vehicle Safety, Taylor & Francis, 2002.
M. Huang, Vehicle Crash Mechanics, CRC Press, 2002.
D. Karnopp, Vehicle Stability, CRC Press, 2004.

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)
3. D. Aleksendric, Vehicle systems, Handouts, 2010. (DVL)
4. Laboratory exercises are covered by appropriate teaching samples of motor vehicle systems, assemblies, and parts. (EOP-LPS)
5. H. Heisler: Advanced Vehicle Technology, Butterworth – Heinemann, 2002

6. T.K. Garrett: W. Newton, W. Steeds, The Motor Vehicle, Butterworth – Heinemann, 2001

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

J.H. Smith (editor): An Introduction to Modern Vehicle Design, Butterworth - Heinemann, 2001.

naval systems

Buoyancy and Stability of Ship 1
Buoyancy and Stability of Ship 1
Ship Equipment
Ship Structures 1
Ship Systems
Ship Systems
Skill Practice B - BRO

Buoyancy and Stability of Ship 1

ID: BSc-0093
teaching professor: Хофман М. Милан
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

Geometry of ship hull: basic definitions and principal dimensions, coefficients of form, the lines drawing, hydrostatic curves. Initial stability of ship: righting moment, metacentric height, metacentric radius, angle of static heel, impact of wind, turning and towing, shifting loads, hanging loads and liquid cargo, dynamic stability. Longitudinal stability of ship: trim and longitudinal shifting loads. Intact stability of ship at large angles of heel: curves of centre of buoyancy, centre of flotation, and metacentre. Cross curves of stability. Righting arm and righting moment curves. Potential energy of stability. Ship with circular, wall-sided and inclined sections. Static and dynamic stability diagram. Angles of static and dynamic capsizing. Practical methods of stability calculation. Parts of ship stability. Asymmetrically loaded ship and ship with negative metacentric height. Ship stability regulations.

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/
[2] Ribar, B., The Theory of Ship, Faculty of Mechanical Engineering, 1987 /In Serbian/
[3] Igor Bačkalov: Instructions for projects in buoyancy and stability of ship /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
K.J. Rawson & E.C. Tupper, Basic Ship Theory, Longmans 1967
Lewis, E.V., (editor): Principles of Naval Architecture, Part 1, SNAME 1987

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

Geometry of ship hull: basic definitions and principal dimensions, coefficients of form, the lines drawing, hydrostatic curves. Initial stability of ship: righting moment, metacentric height, metacentric radius, angle of static heel, impact of wind, turning and towing, shifting loads, hanging loads and liquid cargo, dynamic stability. Longitudinal stability of ship: trim and longitudinal shifting loads. Intact stability of ship at large angles of heel: curves of centre of buoyancy, centre of flotation, and metacentre. Cross curves of stability. Righting arm and righting moment curves. Potential energy of stability. Ship with circular, wall-sided and inclined sections. Static and dynamic stability diagram. Angles of static and dynamic capsizing. Practical methods of stability calculation. Parts of ship stability. Asymmetrically loaded ship and ship with negative metacentric height. Ship stability regulations.

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/
[2] Ribar, B., The Theory of Ship, Faculty of Mechanical Engineering, 1987 /In Serbian/
[3] Igor Bačkalov: Instructions for projects in buoyancy and stability of ship /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
Lewis, E.V., (editor): Principles of Naval Architecture, Part 1, SNAME 1987
K.J. Rawson & E.C. Tupper, Basic Ship Theory, Longmans 1967

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 manly 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

D. J. House: Seamanship Techniques, Shipboard and Marine Operations, Elsevier, Oxford, 2004.
Bosnic, Vukicevic: Oprema broda, Fakultet strojastva I brodogradnje, Zagreb, 1983.
Camac, brod, brodogradnja, Tehnicka enciklopedija, Jugoslavenski leksikografski zavod, Zagreb.
L. Buxton, R. Daggitt, J. King: Cargo Access Equipment for Merchant Ships, E&F. N. Spon Ltd. London 1978.

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 Design and Construction, SNAME, 2003.
D.J. Eyres: Ship Construction, London, 1972.
N. Barabanov: Structural Design of Seagoing Ships, Peace Publishers, Moscow, 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/.
[3] Technical documentation: Examples of ship systems. Catalogues of marine pumps and armature.

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

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/.
[3] Technical documentation: Examples of ship systems. Catalogues of marine pumps and armature.

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 organeles. 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

Examples of systems in biophysics, modeling. Theory of information, quantum computers - examples. Physical methods for separation of molecules. Example of gene expression. Feedback modeling. Replication, transcription, translation. Oral and video presentations. Turing machine, automata theory. Physical methods for testing conformations of biological macromolecules; prediction of secondary and tertiary structures of biopolymers; dynamics of polymerization and depolymerization processes of tubulin ensembles. Collagen - example of continuum mechanics. Oral and video presentations, simulations. Experiment with given voltage - modeling using electric scheme. Hodgkin-Huxley model of ionic conductivity through membrane. Programming cable equation, Hodgkin-Huxley model, and diffusion. Experimental work on electrophysiology. Measuring of action potential. Basics of chemical kinetics. Modeling cell growth on culture medium; modeling of cell cycle. Rheological model of the cell. Fluid dynamics - model. Initiation of the muscle fiber contraction - soliton concept.

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

Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin, The World of the Cell, Benjamin Cummings 2003.
Cristopher T. Fall, Eric S.Marland, John M. Wagner, John J. Tyson, Computational Cell Biology, Springer – Verlag New York Inc, 2002.
Stevan D. Popov, Osnovi biohemijskog inženjerstva, Novi Sad, 2000.
Gordana Matić, Osnovi molekularne biologije, Biološki fakultet univerziteta u Beogradu, 2004.
Charles R. Cantor, Paul R. Shimel, Biophysiacal 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 low, 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:

1. Ammeter and voltmeter in DC circuit. Measuring of resistance by U/I method and Wheatstone's bridge. Measuring of power consumption by U/I method and wattmeter

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

1. D. Kandić: Electrical engineering, FME, Belgrade, 2008 /In Serbian/, ISBN 86-7083-447-2
2. P. Miljanić: Electrical engineering, FME, Belgrade, 1996 /In Serbian/
3. D. Škatarić, N. Ratković, T. Stojić, P. Lukić: A collection of solved problems in electrical engineering, FME, Belgrade, 2000 /In Serbian/, ISBN 86-7083-339-5
4. D. Kandić: Electrical engineering–a collection of solved examination problems, Akademska misao, Belgrade, 2000 /In Serbian/, ISBN 86-7466-025-8
5. D. Škatarić, D. Kandić, T. Stojić, P. Lukić, N. Ratković: Instruction manual for laboratory exercises in electrical engineering, Grafokomerc, Belgrade, 2000 /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

A. Đordjević: Fundamentals of Electrical Enginerring. Part 1, Electrostatics, Akademska misao, Belgrade, 2006 /In Serbian/, ISBN 86-7466-239-0.
A. Đordjević: Fundamentals of Electrical Enginerring. Part 2, DC Currents, Akademska misao, Belgrade, 2006 /In Serbian/, ISBN 86-7466-226-9.
A. Đordjević: Fundamentals of Electrical Enginerring. Part 3, Electromagnetism, Akademska misao, Belgrade, 2006 /In Serbian/, ISBN 86-7466-240-4.
A. Đordjević: Fundamentals of Electrical Enginerring. Part 4, Circuits with time-varying currents, Akademska misao, Belgrade, 2006 /In Serbian/, ISBN 86-7466-220-X.
S. Tešić, D. Vasiljević: Electronics fundamentals, Građevinska knjiga, Belgrade, 2009 /In Serbian/, ISBN 978-86-395-0572-1.

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 characterics, 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 characterics, 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 clampers)
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

1. S. Tešić, D. Vasiljević: Electronics fundamentals, Građevinska knjiga, Beograd, 2009 /In Serbian/, ISBN 978-86-395-0572-1.
2. M. Živanov: Electronics fundamentals-components, FTN, Novi Sad, 2004 /In Serbian/, ISBN 86-85211-16-6
3. M. Živanov: Electronics fundamantals-amplifier circuits, FTN, Novi Sad, 2004, /In Serbian/, ISBN 86-85211-02-6
4. V. Drndarević: Electronics, SF, Belgrade, 2005 /In Serbian/, ISBN 86-7395-181-X
5. B. Aničin: Electronics fundamentals, MF, Beograd, 1995 /In Serbian/
6. M. Živanov: Electronics fundamentals-Exercises, FTN, Novi Sad, 2004 /In Serbian/, ISBN 86-85211-17-4
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

1. A. Sedra, K. C. Smith: Microelectronic circuits, 6th Edition, Oxford University Press, NY, 2011, ISBN 978-019-973851-9.
2. R. Boylestad, L. Nashelsky: Electronic devices and circuit theory, 10th Edition, Prentice Hall, NY, 2009, ISBN 978-0-13-606463-3.
3. T. L. Floyd: Electronic devices, 8th Edition, Prentice Hall, NY, 2008, ISBN 978-0-13-615581-2.
4. R. Tokheim: Digital electronics principles and applications, 7th Edition, McGraw-Hill, NY, 2008, ISBN 978--0-07-312634-0.
5. J. J. Cathey: Theory and Problems of Electronic Devices and Circuits, McGraw-Hill, NY, 2002, ISBN 0-07-136270-3.

Electronics and biomedical measurements

ID: BSc-0030
teaching professor: Лукић 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

Principles of Electrical engineering. Semiconductors and p-n junction, diodes. Bipolar transistors. Basic amplifiers with bipolar transistors. Operational amplifier, feed-back. Principles of medical measurements and instrumentations. Cell's electrical activity. Electrodes for biopotential measurements. Biomedical sensors. Principles of circulatory system and electrical properties of the human heart (cardiac muscle). EKG measurement, measurement of blood pressure, measurement of blood and gas flow. The measuring of the breath amount (volume) and breath speed (flow). The measuring of gas concentration. Muscles contraction, programmable electronic muscle stimulator.

practical teaching

Principles of Electrical engineering - exercise. Numerical examples - Semiconductors and p-n junction. Diodes behavior in electric circuit. Numerical examples - Bipolar transistors. 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

[1] Joseph D. Bronzino (editor): The Biomedical Engineering - Handbook, CRC Press, IEEE Press, USA, 1995. КСЈ
[2] D. M. Škatarić, N. V. Ratković, T. M. Stojić, P. M. Lukić: Solved Numerical Problems in Electro technique, Faculty of Mechanical Engineering, Belgrade, 2000.
[3] D. B. Kandić: Electro technique, Faculty of Mechanical Engineering, Belgrade,2002.

[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

Joseph D. Bronzino (editor): The Biomedical Engineering - Handbook, CRC Press, IEEE Press, USA, 1995.
Dejan Popović, Mirjana Popović: Biomedical instrumentation and equpment, Nauka, Belgrade, 1997.

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

Basics of kinematics. Basic laws of dynamics: Newton's second law of motion, law of inertia, law of action and reaction, conservation of momentum. Types of forces. Oscillations. Work. Conservation of energy. Rotation. Pressure. Pressure in stationary fluids. Buoyancy. Streaming of ideal fluids. Thermophysics. Phase changes. Ideal gas. Mechanical waves. Standing waves. Sound. Resonance. Electromagnetic waves. Physical optics. Modern physics. Basic concepts of metrology. Expression of measurements results and measurements uncertainty. Frequently used measurement equipment in technical measurements.

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 transvese 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 curiculum of study program/module.

learning resources

1)Handouts of lectures. 2)Collection of solved problems in Physics (authors: J.Ilić, Z.Trifković, J.Jovanović, A.Vasić, V.Pavlović; Faculty of Mechanical engineering, University of Belgrade, Belgrade, 2009). 3)Laboratory handbook for experimental work. 4) Lectures in Physics (V.Georgojević et.al., European Commission, Directorate General for Education and Culture, Tempus project number CD_JEP-16123-2001).

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.
Halliday D., Resnick R., and Walker J., Fundamentals of Physics, John Wiley & Sons, 2001
Searway R., Beichner R., Jeweet J., Physics for Scientists and Engineers, Fifth Edition, Editor: John Vondeling, Thomson Learning Inc., 2000

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 pšrocesnoj 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 fluidc
Examples of transport and storage of solids
Examples of economic analysis of processing plants

prerequisite

Entered the sixth semester.

learning resources

Jaćimović B., Genić S., Heat Transfer Operations And Equipment, Part 1: Recuperative Heat Exchangers, Mašinski Fakultet Beograd, 2004.
Jaćimović B., Genić S., Mass Transfer Operations And Equipment, Part 1: Mass Transfer Basics, Mašinski Fakultet Beograd, 2007.
Jaćimović B., Genić S., Mass Transfer Operations And Equipment, Part 2: Mass Transfer Operations, Mašinski Fakultet Beograd, 2010.

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

Jaćimović B., Genić S., Heat Transfer Operations And Equipment, Part 1: Recuperative Heat Exchangers, Mašinski Fakultet Beograd, 2004.
Jaćimović B., Genić S., Mass Transfer Operations And Equipment, Part 1: Mass Transfer Basics, Mašinski Fakultet Beograd, 2007.
Jaćimović B., Genić S., Mass Transfer Operations And Equipment, Part 2: Mass Transfer Operations, Mašinski Fakultet Beograd, 2010.

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 аналзсис, 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

-

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: Јовановић 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 releted 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

Popovic, D., et al., 40 god. nastave na Odseku za procesnu tehnik, Masinski fakultet, Beograd, 1999., p 85., ISBN 86-7083-357-3
Kuburovic, M., Jovovic, A., et al., Zastita zivotne sredine (chapter 15), p. 644-856., Termotehnicar, vol. 2, 2004. ISBN 86-82685-03-5

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

1. Process equipment. Process equipment classification. 2. Working and testing conditions and testing procedures. Nominal pressures and dimensions. 3. Loading types and shell theory – membrane theory. 4. Circular plates – theory of moments. 5. Cylindrical and spherical shells under internal pressure. 6. Cylindrical and spherical shells under external pressure. Reinforcement. 7. Dished ends. Reinforcement. 8. Flat ends and tube sheets. 9.Conical shells. Reinforcement. 10. Vessels support. Support of horizontal and vertical apparatus.

practical teaching

1. Materials for pressure vessels. 2. Pressure vessels classification. 3. Scope of pressure vessel testing and welded joint classification. 4. Laboratory. Pressure vessel - hydrostatic test and tightness test. 5. Flanges. 6. Spherical and cylindrical shells. 7. Torispherical ends. 8. Flat ends and tube sheets. 9. Conical shells. 10. Vessels support. 11. Solving problems related to vessel design.

prerequisite

Students enrolled in third year of bachelor studies; passed exams from the first year of studies.

learning resources

HANDOUTS,
Bogner,M.: Petrovic, A.: Pressure vessels, Bureau for textbooks and teaching tools, Belgrade, 2003.
Bogner, M.: Petrovic, A.: Pressure vessel design, SMEITS, Belgrade, 1991.

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
Bogner,M.: Petrovic, A.: Pressure vessels, Bureau for textbooks and teaching tools, Belgrade, 2003.
Bogner, M.: Petrovic, A.: Pressure vessel design, SMEITS, Belgrade, 1991.

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

1. Determining pipeline dimension. Safety factors, material characteristics, recommended flow speeds, types of standard measures, controlling measures, dimension and materials. 2. Calculation of the thickness of pipe wall with regards to internal pressure. 3. Flanges, types and classes, 4. Examples of calculating self-compensations with and without pre-stressing. 5. Calculations and dimensioning of axial compensator and calculating forces that act in pipelines not laid in canals. 6. Supports, dimensioning and selection. 7. Calculating thermo isolation, selection of type of isolation – characteristics of isolation materials. 8. Dimensioning, materials and selection, sealing, fittings. 9. Determining the output mass flow and safety valve dimensioning. 10. Examples of dimensioning, installing and selecting pressure regulating valves.

prerequisite

Students enrolled in second year of bachelor studies; passed exams from the first years of studies.

learning resources

HANDOUTS,
Bogner,M: Thermo technician, Interklima grafika, Vrnjacka Banja, 2003.
Bogner, M.: Petrovic, A.: Pressure vessel design, SMEITS, Belgrade, 1991.

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
Bogner,M: Thermo technician, Interklima grafika, Vrnjacka Banja, 2003.
Bogner, M.: Petrovic, A.: Pressure vessel design, SMEITS, Belgrade, 1991.

Processes and equipment in environmental engineering

ID: BSc-0650
teaching professor: Јовић 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

Kuburovic, M., Jovovic, A. i dr.: Zastita zivotne sredine, chapter 15, p.644-856., Termotehnicar, tom 2, Interklima, SMEITS, Beograd, 2004., ISBN 86-82685-03-5
Kiely, G., Environmental Engineering, McGraw-Hill, 1997

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

Literature published by members of the Department of Process Engineering. Technical documentation. Cataloging documentation.

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: Бојовић 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

Short introduction to regression analysis: Regression line; General linear regression; random and control variable dependance; general linear regression with control variable; nonlinear regression and multiple linear regression. Introduction to Microsoft Excel Goal Seek and Solver: polinomial root finding, solving systems of nonlinear equations, curve fitting, optimization problems. Treatment of data measurements; Descriptive statistics - summarizing results by a single value; Distribution parameters; Comparing repeated measurements; Calibration curve. Introduction to Symbolic Math Toolbox and MuPAD language. Symbolic algebra, symbolic expressions and operations, equation solving, differentiation, integration, expression simplification, transforms. Analytical models of physical systems. Development of standalone applications using MATLAB. Graphical interface components. Introduction to GUIDE (Graphical User Interface Development Environment). MATLAB and Microsoft Excel data exchanging; accessing MATLAB from Microsoft Excel Spreadsheet. SIMULINK - graphical extension to MATLAB for modeling and simulation of systems.Overview of a simple model. Creating a simple model. Modeling the system with equations. Building the SIMULINK block diagram. Results validation.Signal Builder block. Simulation Data Inspector. Importing data from a Microsoft Excel Spreadsheet. Model configuration. Simulation of the model. Comparing signals in the Simulation Data Inspector.

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, LINEST, 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, TDIST, TINV, TTEST. Solving symbolic mathematic 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

[1] Handouts - lectures.
[2] Software: Microsoft Excel. Matlab
[3] Material for exercises in electronic form available on the website.

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

Bernard V. Liengme and David J. Ellert: A Guide to Microsoft Excel 2007 for Scientists and Engineers. Elsevier, 2008, ISBN: 978-0-12-374623-8.
Tobin A. Driscoll: Learning MATLAB, Society for Industrial and Applied Mathematics (SIAM), 2009, ISBN 978-0-898716-83-2.
Stanley M. Dunn, Alkis Constantinides and Prabhas V. Moghe: Numerical Methods in Biomedical Engineering. Elsevier, 2006, ISBN: 978-0-12-186031-8.

Biomedical Software Basics

ID: BSc-0573
teaching professor: Бојовић 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

Numerical analysis and data processing. Mathematical system and process modeling. Introduction to Microsoft Excel. The main Excel Window and its various parts. The Worksheet. Microsoft Excel specifications and limitations. Basic operations. Using functions in Microsoft Excel. Decision functions and Lookup functions. Import of data list from a non-Excel files. Pivot tables. Charts types and specifications. MATLAB as highly integrated interactive software package and MATLAB as high-level programming language. Introduction to Workspace. MATLAB structure. MATLAB help. Basic commands and syntax. Data importing and saving. Operators and special symbols. Arrays and matrices construction. Matrix and array operations. Sparse matrices. Array/matrix logical functions. Difference between scripts and functions, M-files. MATLAB as programming language. Program control, using control statements. Functions and workspace, local and global variables. MATLAB editor, debugging. Functions as other function arguments and anonymous functions. Sub-functions and nested functions. Memory preallocating. Vectorization. Using masks. Strings. Cell arrays. Structures. Elementary and special X-Y plots. Plot labeling. 3-D plots. Functions for straight and curved line plotting. Contour 2-D and 3-D plots. Surface and mesh plots. 3-D objects. Plot saving, exporting and printing.

practical teaching

Microsoft Excel Quick access Toolbar. Working with shortcuts. Simple arithmetic operators. Working with fractions. Formating (difference between showed and saved values). Practical examples: Effective resistance of resistors in parallel computing; Pressure of a gas at various temperatures and volumes computing, using the van der Waals equation. AutoSum tool. Trigonometry functions, exponential functions, rounding functions, matrix functions. Solving systems of equations in matrix form. Boolean functions. Quadratic equation solver. Examples of lookup functions. Importing a TXT file. Counting and summing with criteria. Frequency distribution. Pivot tables. Data sorting. Data filtering. Line and XY charts. Smooth lines. Formatting data series. Formating axes. Ploting a function. Ploting a function with flexible domain. XY chart with two Y-axes. Control chart. Large numbers and logaritmic scales. Bar chart. Combination chart. Parametric chart. Polar chart. Matrices and matrix operations. MATLAB variables. Basic commands and syntax - demonstration and examples. Basic commands and commands used for variable manipulation in workspace. File commands and command window manipulation. Function and scripts examples: solving linear system of equation using Gauss elimination method, ideal gas volume computing. Complex function plots.

prerequisite

Necessary: Programming, Computer software tools

learning resources

[1] Handouts - lectures.
[2] Software: Microsoft Excel, MathWorks MATLAB.
[3] Material for exercises in electronic form available on the website.

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

Bernard V. Liengme and David J. Ellert: A Guide to Microsoft Excel 2007 for Scientists and Engineers. Elsevier, 2008, ISBN: 978-0-12-374623-8.
Tobin A. Driscoll: Learning MATLAB, Society for Industrial and Applied Mathematics (SIAM), 2009, ISBN 978-0-898716-83-2.
Stanley M. Dunn, Alkis Constantinides and Prabhas V. Moghe: Numerical Methods in Biomedical Engineering. Elsevier, 2006, ISBN: 978-0-12-186031-8.

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).

Computer Graphics

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

McConnell, J., J., Computer Graphics: Theory into Practice, Jones & Bartlett Learning, 2006, ISBN: 0763722502
Xiang, Z., Plastock, R., Schaum's Outline of Computer Graphics, McGraw-Hill, 2000, ISBN: 0071357815

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

Introduction to computer graphics technology. Hardware components for graphics output. Modeling. Geometrical modeling. 2D graphic transformations. Rotation. Translation. Mapping. Scaling. Introduction to 3D graphics. 3D graphic transformations. Graphic representation of objects. Orthogonal projections. Axonometric representation. Stereoscopic representation. Basics of the CAD system. Computer (internal) models. Representation of objects. Line, surface, volume models. Removal of invisible edges. Color graphics. Shadowing. 2D and 3D edges. Analytically describable edges. Analytically indescribable edges. Cubic spline. Bezier curve. B-spline. NURBS curves. Surfaces. Bicubic surface. Bezier surface. Determination of described bodies' characteristics. Surface. Volume. Virtual reality. Animation in computer graphics.

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 indenpendently 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

General principles and simulation examples. Simulation of single-chanel systems, event handling. Introdution to softwares for modelling and analysis of real systems based on discrete event simulation (lab work). Artificial neural networks in intelligent systems. Introduction to softwares for simulation of artificial neural networks (lab work). Recognition systems, simulation of systems of artificial neural networks, simulation of mobile robot motion (examples). Homeworks and seminar works dealing with simulation of real systems and application fo artificial neural networks (recognition systems - robot vision; recognition of manufacturing features of mechanical parts; recognition of objects for grasping - robot vision).

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, 18.1 /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

J. Banks, J. S. Carson, B. L. Nelson and D. M. Nicol (2005), DISCRETE EVENT SYSTEM SIMULATION, 4th Ed., Pearson Education International Series.
E. Alpaydin, (2004) INTRODUCTION TO MACHINE LEARNING, The MIT Press, Cambridge, Massachusetts London, England.
R. R. Murphy, (2000) INTRODUCTION TO AI ROBOTICS, A Bradford Book, The MIT Press, Cambridge, Massachusetts London, England.

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 combinatiorial and sequential circuits, microprocessor, interfaces and networking;
4. Artificial intelligence, self-organization and complexity – principles of self-organization, mathematical pattern recognition, fuzzy logic and neural networks, machine learning and artificial intelligence.

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

1 and 2

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 analyis,
[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

Mesarovic, M.D., Takahara, Y., GENERAL SYSTEMS THEORY: MATHEMATICAL FOUNDATIONS, Academic Press Inc in 1975. , ISBN: 012491540X / 0-12-491540-X
Denning, J. P., Dennis, B. J., & Qualitz, E. Q. (1978). Machines, languages, and computation. Englewood Cliffs, NJ: Prentice-Hall.
Vapnik V. N, The Nature of Statistical Learning Theory, Springer-Verlag, New York, 2000.
Kosko, B., Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence. Prentice Hall,1991, ISBN 0-13-611435-0.

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

1. Step-by-step perception of concepts and themes related to machine tools.
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.
5. Knowledge about the step-by-step concept of machine tools and their selection for a certain type of processing.

theoretical teaching

New teaching contents:
1. Definition, classification and properties of machine tools. Configuration of machine tools. Learning resources.
2. The machine tools saga.
3. Work diagram of the primary motion of cutting machines and electromechanical drives for primary rotary motion.
4. Energy balance in machines for deformation processing.
5. Work diagram of feed motions in metal cutting machines.
6. Machine tools guides.
7. Electromechanical feed drives.
8. Machine tools testing.
9. Machine tools control and programming.
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

1. W. A. Knight, G. Boothroyd, Fundamentals of Metal Machining and Machine Tools, Third Edition, CRC Press, 2005, ISBN 9781574446593.
2. W. R. Moore, Foundations of Mechanical Accuracy, The Moore Special Tool Company, First Edition, Third Printing, 1999.
3. C. Evans, Precision Engineering: An Evolutionary View, Imprint: Cranfield University Press; 1989, ISBN-13: 9781871315011.
4. M. Weck, C. Brecher, Werkzeugmaschinen 1, Maschinenarten und Anwendungsbereiche, Springer, 2005, ISBN 10 3-540-22504-8.
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.
9. LPS-2: Functional simulator for rapid prototyping.
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. 1998, ISBN 0-309-06182-2.
Suk-Hwan Suh, Seong-Kyoon Kang, Dae-Hyuk Chung, Ian Stroud, Theory and Design of CNC Systems, Springer, 2008, ISBN 978-1-84800-335-4.
L.N. López de Lacalle, A. Lamikiz, Editors, Machine Tools for High Performance Machining, Springer, 2009, ISBN 978-1-84800-379-8.
M. Weck, C. Brecher, Werkzeugmaschinen 2, Konstruktion und Berechnung, Springer 2006, ISBN 10 3-540-22502-1.
A. H. Slocum, Precision Machine Design. Society of Manufacturing Engineers, 1998. ISBN13: 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

AT-1: Introduction to manufacturing technology. AT-2: Systems and processes in manufacturing technology. AT-3: Quality system and accuracy of manufacturing. AT-4: Machining by chip removal - turning, drilling, milling, shaping and planing, grinding, etc. Determination of the principle factors of the machining process. AT-5: Non-traditional machining methods: ultrasonic machining, electro-discharge machining, electro-chemical machining and combined methods. AT-6.: Metal forming processes. AT-7: Bulk deformation processes and sheet metalworkong processes. AT-8: Automation in production process.

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/
Kalajdžić, M. et al. Cutting technology - a handbook, FME, Belgrade, 2006, КПН /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/
[3] Textbook of production metrology /In Serbian. In preparation/
[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 областии 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

The study of integrated quality assurance system for the university. The quality of teaching. The quality of research. Integration of teaching and research. Students in the management of faculties and universities. Academic performance of students and teachers. Business performance of faculties and universities. European Qualifications Framework. Bologna Declaration

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

Integration in Europe. Declaration in the development of education. Partial and common problems of university and industry and common business excellence. Theory for designing an integrated system of quality of education. Models for quality assurance. Standards and procedures for quality of education. The quality of teaching and professional training of engineering education. Cognitively mature students through the learning process. Methods of teaching, learning and assessment. Monitoring the progress of students through the study. Academic performance of students. Creative and innovative experts. Andragogical-pedagogical performance of teachers. Evaluation and accreditation. Alumni Association. Student activities. Centers of Excellence and Education. Information and communication infrastructure.

practical teaching

Analysis of the quality of engineering education. Development of prediction methods. Synthesis of integrated system of education. Indicators of the quality of engineering education. Business performance of faculties and universities. Andragogical and the academic performance of teachers. Work and academic performance of students. The system of questionnaires for students. Alumni - observer status. Learning in depth. Project-oriented teaching. Seminars, conferences and debates. Students acquire skills in writing and presentation of scientific papers for professional meetings.

prerequisite

Defined in the curriculum of study program / module.

learning resources

Spasić, Ž., integrated system of quality of digital university, MF, 2007.
Spasić, Ž., Information integration of business functions, Textbook, MF, 2009.

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

The theory of the cutting process. Principal factors of the machining process: cutting forces and cutting speed. Mathematical theory of plasticity and physics of solid body plastic deformation (hypotheses, solid body models). Plastic deformation mechanism. Continuum mechanics. Plate elastic after-effect. Deformation force and machining by: punching, stamping out, bending and drawing. Determination of the press force. Preparations for shipbuilding, technological processes design in shipbuilding, technical standardization, basics of numerical tracing.

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

active teaching (theoretical)

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
S. Kalpakjian: Manufacturing Engineering and Technology, Addison-Wesley Pub. Com., 1995, 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

[1] Handouts (pdf files). [2] Laboratory equipment (tools and machines) at the Institute for machine tools. [3] Laboratory experimental equipment at the Institute for machine tools. [4] CAx software workstation (CAD, CAM, CAE, CAPP,...)

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

"Технологија машиноградње", М. Калајџић, Машински факултет, Београд, 2008.
"Алати и прибори", Љ. Тановић, М. Јовичић, Машински факултет, Београд, 2005.
"Управљање квалитетом производа 1", В. Мајсторовић, Машински факултет, Београд, 2000.
"Пројектовање технолошких процеса", Б. Бабић, Машински факултет, Београд, 1999.
"Аутоматизација производних процеса - лабораторија", М. Пилиповић, Београд, 2006.

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

Theory of the principles of work-piece locating and positioning. Theory of the cutting process, determination of the principle machining factors, deformation force and deformation work. Stability theory. Theory of elastoplastic deformation. Determination of the principle machining factors in plastic deformation processing. Construction and computations for elements of clamping fixtures, computations for clamping fixtures accuracy, sheet-metal processing tools, construction characteristics of tool elements, forging tools, metal pressure casting tools, and forming and shaping plastics tools.

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

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. Simic, 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

The fundamental structural assemblies and the main parameters in designing rail vehicles. Regulations for design, operation and maintenance of railway vehicles. One axle running gear. Typical bogie types for freight wagons and passenger coaches. Suspension system. Carbody - bearing structure. Review of the regulations concerning strength of the carbody and bogie structures. Draw-buff gear: fundamental characteristics, main types. Vehicle gauge. Fundamental criteria of the dynamic behavior of rail vehicles. Fundamental design concepts and functioning principles of the rail vehicle brakes.

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: Лучанин 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: Лучанин 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.
Andreas Steimel, Electric Traction - Motive Power and Energy Supply, Oldenbourg Industrieverlag Munich, 2008.

ID: BSc-0652
teaching professor: Лучанин Ј. Војкан
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 6
final exam: oral
parent department: railway mechanical engineering

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: Миловanчевић 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

Theoretical instruction. Introduction. The connection between strength and deformation. The shape of the body. Geometrical properties of the cross-sections. The principal moments of inertia and the ellipse of inertia. Types of forces. The concept of stress and strain. Equilibrium conditions in the cross-section. Axial loading: terms of balance, the impact of temperature, the ideal shape. The concept of static indeterminacy. Force method. Analysis of stress and dilatation in staff cross-section. Conjugate stresses. Plane stress state. Shear. Torsion: terms of balance, angle of torsion, shear stress and dimensioning, the ideal shape, static indefinite problems. Bending: introduction, pure bending: terms of balance, resistance moment, normal stress; bending forces: shear stress, the ideal form of curved beams, standard sections; bending deformation.

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 Anđelić (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

The stability of compressed baems- buckling. Statically indeterminate beams. Decomposition method. Deformation energy: the concept, a general term, additional work. Theorem of reciprocity. Kastigliano’s theorems. Maxwell-Mohre integrals and Verescagin’s procedure. Statically indeterminate problems. Canonical equation. Force method. Symmetric planar structures. Analysis of stress and strain. Volumetric strain. Hypotheses about the fracture of the material. Calculation of the stucture complex stress. Bending in two plains: the concept, stress, strain. Shear center. Excentric force load. Displacement method: introduction, setting. Basis of the FEM. Methods of defining the problem. Types of finite elements.

practical teaching

The tasks of buckling. Examples of statically indeterminate beams. Determination of displacements for staticaly 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

1.Tables of Strength of Materials: D. Ruzic, R. Cukic, M. Dunjić, M. Milovančević, N. Andjelic, V. Milosevic Mitic
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 machanisms 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.)
Hidraulic 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 machanisms 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

Introduction to the subject, mechanical operations. Understanding the basics of the technological processes in mechanical engineering Food: Cereal, milk and dairy products, fruits and vegetables and meat. Classification of basic technological operations in proivodnji food products. Mechanical operations: milling, grinding, shredding, chopping, peeling, seeding. Mixing board, laminating, pressing, straining, filtration, centrifugation, precipitation, weighing, dosing, injection molding, extrusion, sorting, calibration. Types of mixtures. Power required for mixing. The optimal speed while mixing. Pressing the production of cheese and cheese. Pressing-juicing fruits and vegetables thermal operations in food products. Review of basic thermal operations in the production of food products: baking, roasting, drying, smoking. Drying phase. Influences of various factors in thermal. Exchange of heat, refrigeration. Heating and cooling liquid in the container. Heat sources and methods of heating. Capacitors. Budget capacitors. Natural and artificial cooling. Refrigerants. Compressors. Scheme compressor cooling plant. Other operations in the food mechanical engineering. Internal transportation: air, hydraulic and mechanical. Belt, inspection, screw, chain transport. Transport cans. Sectional transport bottles. Piping and fittings. Selection meterijala pipes and fittings for use in food inustriji. Pipes of cast iron, cast steel, carbon steel, galvanized steel pipes, stainless steel, bakarene pipes, glass pipes, tubes, etc. platične. Compensators. Lire. Seals. Thermal insulation, heating, defrosting and marking the pipe. Regulation and measurement of fluid flow. Valves. Valves. Taps. Elektromegneti. Setting the tube.

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: Попконстатиновић Д. Бранислав
level of studies: B.Sc. (undergraduate) academic studies
ECTS credits: 2
final exam: written
parent department: theory of machanisms 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 machanisms 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 machanisms 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 defineing 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. Moreower, 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 machanisms 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 seminaries.

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 machanisms 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

Introduction to hydraulic and pneumatic systems. Way of working and different concepts of hydraulic and pneumatic cylinders - Design of pneumatic cylinder as the basic components of pneumatic mechanisms. Pneumatic and hydraulic valves -Showing construction and operation of pneumatic and hydraulic components distributor as a cylinder control device. Air preparation. Accessories and associated equipment. Standard cylinder speed control. Symbols in hydraulics and pneumatics. Proportional techniques - flow and pressure proportional valve. Vacuum techniques -different ways of producing vacuum: using vacuum pumps, ejector device (venture principle). Calculations for hydraulic and pneumatic systems and installations. Examples of application of hydraulic and pneumatic machinery and installations.

practical teaching

Getting familiar with different models of pneumatic cylinders. Getting familiar with different models of hydraulic cylinders. Connect simple installation with one cylinder and one valve. The importance of air preparation. The consequences of poor air preparation. Introduction to different configurations of air preparation service units. Elements for connecting a hydraulic and pneumatic installation. Development of pneumatic and hydraulic schemes. The positioning of pneumatic cylinder with flow proportional valve. Calculation of air consumption. Examples.

prerequisite

To attend classes of the subject Hidraulic and Pneumatic Mechanisms and Piping, no condition is necessary.

learning resources

Software for creation and calculation of hydraulic and pneumatic schemes. Software package for simulation of hydraulic and pneumatic mechanisms. The textbook is in preparation. Handout.

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 machanisms 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 softvare; 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 softvare, writing a part program for the synthesis in MATLAB softvare; Parametric optimal synthesis of mechanisms for a given path (MATLAB) design obtained by synthesis mechanism by WORKING MODEL softvare.

prerequisite

No condition.

learning resources

A.Sekulić: Mechanism Design
B.Gligorić: Mechanisms
WORKING MODEL-Softvare 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.: Steam turbines, script, 2004.
Petrovic, M.: Gas turbines and compressors, script, 2004.
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

Petrovic, M.: Steam turbines, script, 2004.
Stojanovic, Thermal Turbomachinery, Gradjevinska knjiga, Belgrade, 1967.
Vasiljevic, N.: Steam turbines, Faculty of Mechanical Engineering, Belgarde, 1987.
Petrovic,, Gas turbine and turbocompressors, script, 2004.
Boyce, M.: Gas turbine engineering hadbook, GPB, Boston 2002.

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. Hydroelectric power 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

Kleinpeter, M., Energy Planning and Policy, John Wiley & Sons, New York, 1995.
Chateau, B., Lapillonne, B., Energy Demand: Facts and Trends, Springer-Verlag, New York, 1982.
Woodruff, E., B., Lammers, H.B., Lammers, T.F., Steam Plant Operation, McGraw-Hill, 1998.
Eastop, T.D., Croft, D.R., Energy Efficiency, Longman Scientific & Technical, Harlow, 1990.

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, termodynamic 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 tempreratures 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 pased exam in thermodyinamics.

learning resources

Lecture handouts

Textbook: B. Todorovic: Designing systems for central heating, Faculty of Mechanical Engineering, Belgrade, 2007.

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. Маја
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 temprerature 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; Inluence 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. Маја
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 educationof 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: Бањац 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 engereering, 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-mehanical devices and facilities that are used in the area of thermo-technique, thermo-energetic and processes engereering. 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.
6.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

1. Vasiljevic, B., Banjac, M.: Map of Thermodynamics, Faculty of Mechanical Engineering of University of Belgrade, 114 pages., Beograd, 2010. (in Serbian)
2. Vasiljevic, B., Banjac, M.: Manual for Thermodynamics, tables and diagrams, Faculty of Mechanical Engineering of University of Belgrade, 325 pages, Beograd, 2010.(in Serbian)
3. Handouts (Prof. Dr. Milos Banjac), available in electronic form (in Serbian)
4. Voronjec, D., Kozic, D.: Moist Air, SMEITS, Belgrade, 2005.(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

Vasiljevic, B., Banjac, M.: Map of Thermodynamics, Faculty of Mechanical Engineering of University of Belgrade, 4th edition, 114 pages., Beograd, 2010. (in Serbian)
Vasiljevic, B., Banjac, M.: Manual for Thermodynamics, tables and diagrams, Faculty of Mechanical Engineering of University of Belgrade, 1st edition,325 pages, Beograd, 2010. (in Serbian)
Voronjec, D., Kozic, D.: Moist Air, SMEITS, Belgrade, 2005.(in Serbian)
Cengel, Y., Boles, M.: Thermodynamics: An Engineering Approach with Student Resources DVD, McGraw-Hill Science/Engineering/Math; 7th edition, 1024 pages, 2010.
Moran, M., Shapiro, H: Fundamentals of Engineering Thermodynamics, Wiley, 6th edition, 944 pages, 2007

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.
2. Milinčić, D.: Heat transfer, Mašinski fakultet, Beograd, 1989.
3. Kozić, Đ., Gojak, M., Komatina, M., Antonijević, D., Saljnikov, A.: Exercises in heat transfer, Mašinski fakultet, Beograd, 2002.
4. Milinčić, D., Vasiljević, B., Đorđević, R.: Problems in heat transfer, Mašinski fakultet, Beograd, 1991.
5. Kozić, Đ., Vasiljević, B., Bekavac, V.: Handbook for thermodynamics, Mašinski fakultet, Beograd, 2006.

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

F.P. Incropera, D.P. deWitt: Fundamentals of Heat Transfer, John Wiley & Sons, 1980.
J.P. Holman: Heat Transfer, McGraw Hill, 2002

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 (ε – NTU method).
5. Heat transfer by radiation (thermal radiation) – basic mechanisms, wave and quantum theory, basic laws; radiation between two surfaces.

practical teaching

1. Numerical exercises: steady state conduction, bodies with interior heat sources, critical thickness of pipe insulation, bars and fins. Numerical methods.
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 (ε-NTU method).
4. Numerical exercises: heat transfer by radiation between two surfaces. Combined heat transfer problems.

prerequisite

Physics

learning resources

1. Хендаути. Handouts
2. Милинчић, Д.: Простирање топлоте, Машински факултет, Београд, 1989.
3. Козић, Ђ., Гојак, М., Коматина, М., Антонијевић, Д., Саљников, А.: Збирка задатака из преношења топлоте, Машински факултет, Београд, 2002.
4. Милинчић, Д., Васиљевић, Б., Ђорђевић, Р.: Проблеми из преношења топлоте, Машински факултет, Београд, 1991.
5. Козић, Ђ., Васиљевић, Б., Бекавац, В.:Приручник за термодинамику, Машински факултет, Београд, 2006.
6. F.P. Incropera, D.P. deWitt: Fundamentals of Heat Transfer, John Wiley & Sons, 1980.
7. J.P. Holman: Heat Transfer, McGraw Hill, 2002
8. Cengel, Y.: Heat Transfer A Practical Approach, McGraw - Hill, 2003

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

F.P. Incropera, D.P. deWitt: Fundamentals of Heat Transfer, John Wiley & Sons, 1980.
J.P. Holman: Heat Transfer, McGraw Hill, 2002
Cengel, Y.: Heat Transfer A Practical Approach, McGraw - Hill, 2003

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

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

practical teaching

Determining the state properties, ideal gas equation of state. First law of thermodynamics for closed system, quantity of heat, performed work, thermodynamic system energy change. Specific heat capacity, specific heat capacities of gases. First law of thermodynamics for open system. Second law of thermodynamics, entropy change of the isolated thermodynamic system. Polytropic state changes of ideal gas, examples, presentation in diagrams of state. Determining thermodynamic quantities and applying thermodynamic laws on mixtures of ideal gases. Real pure substances – water vapor: diagrams of state, state properties, state changes. Cycles of heat engines; basic cycles of the internal combustion engines, gas-turbine and vapor-turbine power plants. Basic refrigeration cycles. Numerical exercises of the energy transfer by heat.

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
3. Vasiljević, B., Banjac, M.: Handbook for thermodynamics – tables and diagrams, 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

Load on the artillery weapon carriage during firing. Types of gun mounts. A typical design and function principles of recoil braking systems. Basic types of construction solutions of gun barrels. Basic types and mechanisms of the breechblock. Types of devices on the gun mount. Basic characteristics and operating mechanisms of small arms. Automatic weapons based on the blow back operation. Automatic weapons with recoil operation. Recoil intensifiers and accelerators. Automatic weapons on the principle of gas operation. Types of locking and mechanical safety. Cartridge case extraction and ejection mechanisms, feed systems, trigger and firing mechanisms. Muzzle devices (muzzle breaks, flash hiders, silencers, muzzle deflectors). The characteristics of the construction of automatic cannons with their own or external power source. Concept and characteristics of self-propelled artillery weapons and tanks.

practical teaching

Load on the artillery weapon carriage during firing. Calculation of the recoil braking system. Calculation of gun barrels. Basic types and mechanisms of the breechblock. Automatic weapons based on the blow back operation. Characteristic examples of the function of automatic weapons with recoil operation and with gas operation. Types of locking and mechanical safety. Cartridge case extraction and ejection mechanisms, feed systems, trigger and firing mechanisms. Muzzle devices (muzzle breaks, flash hiders, silencers, muzzle deflectors).

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
Allsop D.F., Toomey M.A.: Small Arms - General Design, Brassey's, London, 1999

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 (funamentals).
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

1. Blagojevic, Dj.: Flight mechanics of projectiles - lectures, Belgrade, 2010.

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

McCoy, R.L.: Modern Exterior Ballistics, Shiffer Publishing, 2012.

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).
3. Gunpowder. Propellant charge. Physical, chemical and ballistic characteristics of gunpowder. Combustion of gun propellant.
4. Basic processes and laws during the firing process. The main tasks of the internal ballistics.
5. Energy balance during the firing process. The basic equations of interior ballistics. Corrective formulas of interior ballistics.
6. Basics of reactive propulsion; classification of reactive propulsion (air-breating and rocket); classification of rocket propulsion (liquid, solid and hybrid).
7. The basic equations of propulsion systems performances.
8. Fundamentals of air-breathing propulsion.
9. Fundamentals of rocket engines with liquid propellants.
10. Fundamentals of rocket motors with solid propellants.
11. Software packages for reactive motor performance calculation.

practical teaching

1. Combustion of gunpowder. Examples of calculations
2. The main tasks of the interior ballistics. Energy balance during the firing. The basic equations of interior ballistics. Solving problems.
3. Corrective formulas of interior ballistics. Selected examples.
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

1. Jaramaz, S., Mickovic, D.: Interior ballistics, Faculty of Mechanical Engineering, Belgrade, 2002. (in Serbian)
2. Blagojevic, Dj., Milinovic, M.: Scripts for lessons - Rocket propulsion

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 Đ., Milinovic M., Micković D.: Handouts
2. Jaramaz S., Micković D.: Internal ballistics, Faculty of Mechanical Engineering, Belgrade, 2002.

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 weapons 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 weapons 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
2. Arsic, S.: Contemporary armament, Belgrade, 1996 (in Serbian)
3. Petrovic, D.: World artillery, Belgrade, 2002,(in Serbian)
4. Andjelkovic, M.: Fundamentals of rocket engineering, Belgrade, 2005, (in Serbian)

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 analises for rocket ,and special for nissiles and its diferences . 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.

2. Mass model exercises for the unguided artillery rockets, and MLRS integration principles. Practical calculation performances
3. Evaluation and research of maximum velocities of ideal and real flight for ballistic launching by Tziolkowsky equations. Calculation performances exercise.
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
3. 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

L.Davis, at all, Exterior Ballistics of Rockets, van Nostrad, Princeton, New Jersey USA, 1960.
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
2. Milinović M.: Basis of rockets and launchers design, 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